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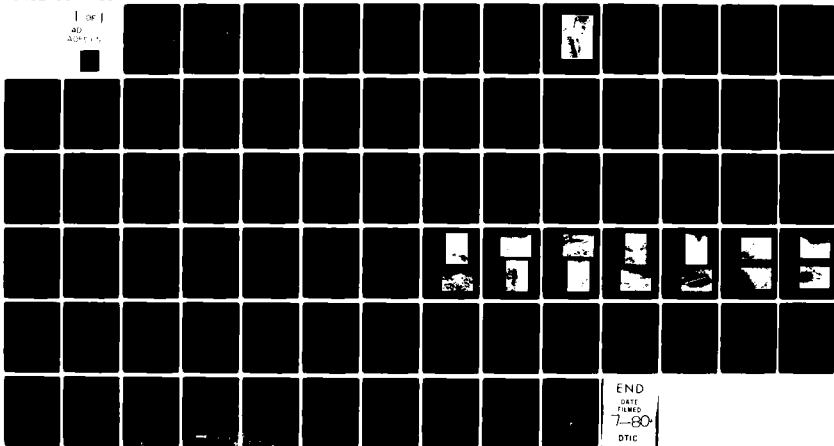
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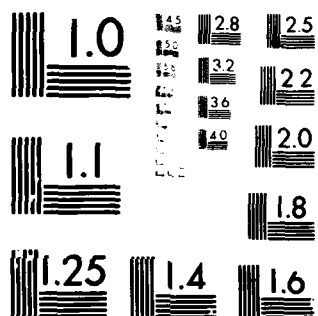
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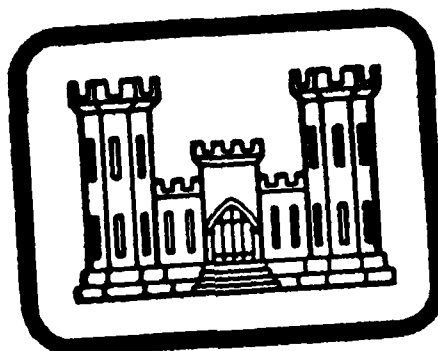
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PENNSYLVANIA

NDI No. PA 00212
PENN DER No. 26-31

STAR JUNCTION No.2 DAM
WILLIAM McCORMICK

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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JUN 6 1980
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PREPARED FOR

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS
BALTIMORE, MARYLAND 21203

BY *Enr*

ACKENHEIL & ASSOCIATES ~~GEO SYSTEMS, INC.~~
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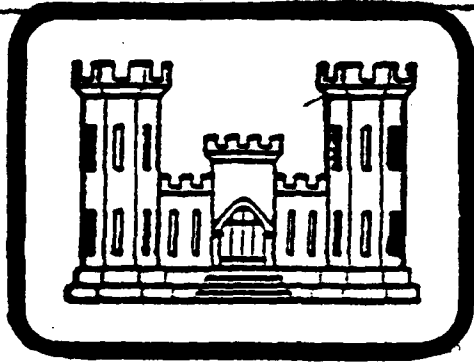
STAR JUNCTION NO. 2 DAM
FAYETTE COUNTY, COMMONWEALTH OF PENNSYLVANIA
NDI NO. PA 00212
PennDER NO. 26-31

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~~WILLIAM MCCORMICK~~ See p11

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6 PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM.



Prepared for: DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

Prepared by: ACKENHEIL & ASSOCIATES GEO SYSTEMS, INC.
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1000 Banksville Road
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Star Junction number 2 Dam.
(NDI Number PA00212 PennDER number 26-31)
Ohio River Basin, Fayette County, Commonwealth
of Pennsylvania. Phase I Inspection
(Program)

Date: 11 April 1980

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams for Phase I investigations. Copies of these guidelines may be obtained from the Department of the Army, Office of Chief of Engineers, Washington, D.C. 20314.

The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon visual observations and review of available data. Detailed investigations and analyses involving topographic mapping, subsurface investigations, materials testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify the need for such studies which should be performed by the owner.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of the dam depends on numerous and constantly changing internal and external factors which are evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some time in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be improved.

Phase I investigations are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" (PMF) for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

SYNOPSIS OF ASSESSMENT AND RECOMMENDATIONS

NAME OF DAM:	Star Junction No. 2
STATE LOCATION:	Pennsylvania
COUNTY LOCATION:	Fayette
STREAM:	Unnamed tributary of Washington Run, a tributary of the Youghiogheny River.
DATE OF INSPECTION:	14 November 1979
COORDINATES:	Lat. 40°03'24", Long. 79°45'22"

ASSESSMENT

Dam: Star Junction No. 2 dam consists of an earthfill embankment and masonry spillway on the left abutment. The dam has a crest length of 341 feet, a maximum height of 30 feet and a storage volume of 31 acre-feet at the spillway crest level. The dam is classified by Corps of Engineers guidelines to be a "small" size, "high" hazard structure.

Evaluation: Based on the visual observations and the data available, the dam is categorized as being in need of additional investigations.

Owner: The dam is owned by Mr. William McCormick of Bentleyville, Pennsylvania.

Embankment: Star Junction No. 2 dam's embankment is assessed to be in poor condition. This is based on visual observations of the non-uniform slope, wet zones and state inspection reports. The inability to closely inspect the crest, downstream slope, groins, and abutments due to dense brush, weeds, trees and debris is considered to be a deficiency. Other minor deficiencies were also observed.

Outlet Works: The condition of the reported eight inch cast iron outlet pipe could not be determined. The downstream control was observed to be damaged and probably is not operable. No control or mechanism was observed to permit upstream flow control.

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SYNOPSIS OF ASSESSMENT AND RECOMMENDATIONS (CONT'D)
Star Junction No. 2 Dam

Principal Spillway: The principal spillway is assessed to be in very poor condition. This is based on visual observations of the weir wall and training dike retaining wall. Both structures are partially collapsed and badly deteriorated and safe performance is questionable in the event of long-term, high discharge conditions.

Reservoir/Spillway Capacity: Hydrologic/hydraulic computations performed in accordance with criteria established by the Baltimore District, U. S. Army Corps of Engineers, for Phase I inspections indicated that the spillway will pass only 0.45 PMF without overtopping the dam. Because of downstream conditions, the Spillway Design Flood (SDF) for Star Junction No. 2 dam is the PMF. At 0.5 PMF, the embankment is overtopped by a maximum 0.27 feet for 65 minutes. In the opinion of the evaluating engineer, this amount of overtopping is not sufficient to cause failure of the embankment. This is based on soil type, soil firmness and vegetal cover.

Spillway Adequacy: According to Corps of Engineers guidelines, Star Junction No. 2 dam spillway is "inadequate" but not "seriously inadequate".

RECOMMENDATIONS

1. Additional Investigations. It is recommended that the owner immediately retain the services of a registered professional engineer knowledgeable and experienced in the design and construction of earth dams and masonry spillways to provide a detailed engineering investigation of Star Junction No. 2 dam. This investigation should include but not be limited to the following:

(a) Detailed evaluation of spillway capacity and stability and development of recommendations for remedial action.

(b) Detailed investigation of the seepage and wet conditions and structural stability of the embankment.

(c) Investigation of the outlet works with specific recommendations on making it operable and including provisions for upstream flow control.

SYNOPSIS OF ASSESSMENT AND RECOMMENDATIONS (CONT'D)
Star Junction No. 2 Dam

2. Emergency Operation and Warning Plan. Concurrent with the additional investigations recommended above, the owner should develop an Emergency Operation and Warning Plan including:

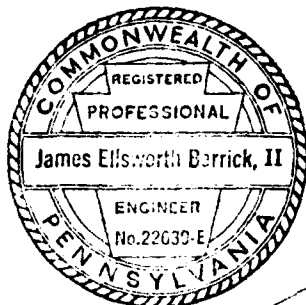
- (a) Guidelines for evaluating inflow during periods of heavy precipitation or runoff.
- (b) Procedures for around the clock surveillance during periods of heavy precipitation or runoff.
- (c) Procedures for rapid drawdown of the reservoir under emergency conditions.
- (d) Procedures for notifying downstream residents and public officials, in case evacuation of downstream areas is necessary.

3. Remedial Work. The Phase I Inspection of Star Junction No. 2 dam also disclosed several deficiencies of lower priority which should be corrected immediately.

- (a) Closely mow the embankment slopes, crest, groins, abutments and immediate downstream areas. Remove the cuttings from the site.
- (b) Locate and backfill completely, all animal burrows on the embankment, groins and adjacent abutment areas.
- (c) Replace lost riprap along the upstream slope of the embankment.
- (d) Fill wheel ruts and minor erosion gullies on the embankment and adjacent areas.
- (e) Raise the embankment crest to design elevation.
- (f) Remove boulders, trees, duntimber and debris from the principal spillway approach and discharge channel.
- (g) Develop and implement formal maintenance and inspection procedures.

SYNOPSIS OF ASSESSMENT AND RECOMMENDATIONS (CONT'D)
Star Junction No. 2 Dam

4. **Orderly Breaching:** In lieu of performing the above recommendations, the owner should engage the services of a professional engineer, knowledgeable in dam design and performance, to prepare specifications for breaching the structure, to make it incapable of impounding water. The structure should then be breached under the direction of the professional engineer and in accordance with applicable state and local regulations.



James P. Hannan 18 April 1980
James P. Hannan Date
Project Engineer

James E. Barrick 18 April 1980
James E. Barrick, P.E. Date
PA Registration No. 022639-E

Approved by:

James W. Peck
JAMES W. PECK Date
Colonel, Corps of Engineers
District Engineer

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STAR JUNCTION No.2 DAM



OVERVIEW

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
STAR JUNCTION NO. 2 DAM
NATIONAL I. D. NO. PA 00212
PennDER NO. 26-31

SECTION 1
PROJECT INFORMATION

1.1 GENERAL

a. Authority: The Phase I investigation was performed pursuant to authority granted by Public Law 92-367 (National Dam Inspection Act) to the Secretary of the Army through the Corps of Engineers, to conduct inspections of dams throughout the United States.

b. Purpose: The purpose of the investigation is to determine whether or not the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Dam and Appurtenances: The dam consists of an earth embankment and a masonry spillway located at the left abutment.

(1) Embankment: The embankment is constructed of earth founded on clay and is 300 feet long (excluding spillway), 30 feet high toe to crest, and has crest widths varying from 14 to 16 feet. The upstream slope is 1.7H:1V and the downstream slope varies with a maximum of 2H:1V.

(2) Outlet Works: Available design information indicates that the outlet works consists of an eight inch cast iron pipe through the embankment.

(3) Spillway: The principal spillway consists of a concrete capped, masonry weir wall located between the left abutment and the left end of the embankment. The weir crest is 41 feet long, approximately 3 feet wide and is at Elev. 1064.9 feet. Normal base flows are currently discharged through and beneath the weir wall. Normal freeboard at the dam is 4.3 feet.

(4) Downstream Conditions: The reservoir formed by Star Junction No. 1 dam lies immediately downstream of Star Junction No. 2 dam, such that the toe of

No. 2 dam is inundated to a depth of 7.5 feet. No. 1 dam and spillway are 1200 feet downstream of the toe of No. 2 dam.

(5) Flood Plain Development: At least thirteen inhabited dwellings lie on the floodplain in the first 2000 feet below Star Junction No. 1 dam. In the first two miles below that dam, the floodplain contains State Route 51, a major north-south highway, the village of Star Junction and the Borough of Perryopolis.

(6) Reservoir: Star Junction No. 2 dam impounds a reservoir with a normal length of 700 feet and normal surface area of six acres. When the pool is at the crest of the dam, the reservoir length is 1000 feet and the surface area is eight acres.

b. Location: Star Junction No. 2 dam is located two miles southeast of Star Junction, Perry Township, Fayette County, Pennsylvania. The dam is situated on an unnamed tributary of Washington Run, which flows into the Youghiogheny River near Layton, Pennsylvania.

c. Size Classification: This dam has a storage capacity of 59 acre-feet at the embankment crest and a maximum toe to crest height of 30 feet. Based on this data, the dam is classified as a "small" size structure.

d. Hazard Classification: Star Junction No. 2 dam is classified as a "high" hazard dam. In the event of a dam failure, Star Junction No. 1 dam, numerous inhabited dwellings and considerable commercial development on the floodplain below the dam would be subjected to substantial damage and loss of life could result.

e. Ownership: Star Junction No. 2 dam is owned by Mr. William McCormick. Correspondence can be addressed to Mr. William McCormick, Box 998, Bentleyville, Pennsylvania 15314 (412-239-4433).

f. Purpose of Dam: Star Junction No. 2 dam served to impound water for domestic use in Star Junction until July 1979; its current use is unknown. It was originally designed to supply water for industrial use by the Washington Coal and Coke Company.

g. Design and Construction History: Star Junction No. 2 dam was designed by Thomas M. Zimmerman of the Washington Coal and Coke Company and was built between 1900 and 1901. In 1915, several improvements were recommended and subsequently constructed.

(1) The spillway was enlarged to provide a discharge capacity of 400 cfs.

(2) The crest of the embankment was raised by one foot to provide a level surface throughout the length of the crest.

(3) Riprap was placed on the upstream embankment slope.

(4) The downstream spillway channel was lined with large flat stones.

(5) The approach spillway was excavated to provide an efficient approach slope.

1.3 PERTINENT DATA

- a. Drainage Area: 0.77 sq. miles
- b. Discharge at Dam Facility:
- | | |
|---|----------|
| Maximum Known Spillway Flood
(4 June 1941) | 730 cfs* |
| Spillway Capacity at Top of Dam (1979) | 969 cfs |
- c. Elevation: (Feet above MSL).
- | | |
|--------------------------------|---------|
| Current Top of Dam (Low Point) | 1069.2 |
| Normal Pool | 1064.9* |
| Spillway Crest | 1064.9* |
| Maximum Tailwater | N/A |
| Inlet Invert of Outlet Pipe | Unknown |
| Streambed at Toe of Dam | 1039+ |
| Base of Embankment | 1039+ |
| Outlet Invert of Outlet Pipe | Unknown |
- d. Reservoir Length:
- | | |
|------------------------|-----------|
| Length of Maximum Pool | 1000 feet |
| Length of Normal Pool | 700 feet |
- e. Reservoir Storage:
- | | |
|--------------------|---------------|
| Current Top of Dam | 59 acre-feet |
| Spillway Crest | 31 acre-feet* |
| Normal Pool | 31 acre-feet* |

f. Reservoir Surface:

Current Top of Dam	8 acres
Spillway Crest	6 acres*

g. Embankment:

Type	Earthen
Length	300 feet
Height	30 feet
Slopes:	
Downstream	2H:1V maximum
Upstream	1.7H:1V
Minimum Crest Width	14 feet

h. Outlet Works:

Type	8 inch cast iron pipe*
Inlet	Unknown
Conduit Length	Unknown
Gate Valve	Downstream
Anti-seep Collars	Unknown

i. Principal (Ungated) Spillway:

Type	Masonry and concrete weir wall with training wall (embankment side)
Cross-section	Rectangular
Weir Crest Length	41 feet
Weir Crest Elevation	1064.9 feet*
Gate or Control	None

*Taken from available engineering data in PennDER files.

SECTION 2 ENGINEERING DATA

2.1 DESIGN

The files of the Commonwealth of Pennsylvania, Department of Environmental Resources (PennDER) were reviewed but no engineering data related to the original design of the embankment and spillway was found. A portion of a plan drawing for the reservoir, dated October 1900, was obtained and reviewed. The owner could provide no data on this dam.

2.2 CONSTRUCTION

No information was found related to the original construction of this dam.

2.3 MODIFICATION/REPAIR

PennDER files indicated that modifications were made to the dam in 1915. These included raising the crest and repairing crest erosion, and replacing the spillway weir wall and improving spillway abutments and channels. The improvements were ordered by the Water and Power Resources Board (predecessor to PennDER).

2.4 OPERATION

The dam was designed to operate without a dam tender, and no operational data is available. The outlet works pipeline required attention for both operation and maintenance. However, no records of such operation and maintenance were available.

2.5 EVALUATION

a. Availability: Engineering data was provided by PennDER, Bureau of Dams and Waterways Management.

b. Adequacy: The available engineering information, though greatly limited, was supplemented by field inspections and supporting engineering analyses and is considered adequate for the purpose of this Phase I inspection report.

c. Validity: Based on the review of the available information, there appears to be no reason to question the validity of the limited engineering data.

SECTION 3
VISUAL INSPECTION

3.1 FINDINGS

a. General: The initial visual observations of Star Junction No. 2 dam and reservoir were performed on 14 November 1979, and consisted of:

- (1) Visual observations of the embankment crest and slopes, groins, and abutments;
- (2) Visual observations of the spillway including weir wall, training wall and dike, and approach and discharge channels.
- (3) Visual observations of downstream conditions and evaluation of the downstream hazard potential.
- (4) Visual observations of the reservoir shoreline, inlet stream channels and watershed.
- (5) Transit stadia survey of relative elevations along the embankment crest centerline and spillway, and across the embankment slopes.

The visual observations were made during periods when the reservoir and tailwater were at normal operating levels.

Supplemental observations were performed on 1 February 1980 to:

- (6) Obtain additional photographs for report presentation.

The visual observations checklist, field plan, profile and section, containing the observations and comments of the field inspection team are contained in Appendix A.

Specific observations are illustrated on photographs in Appendix C. Detailed findings of the visual inspection are presented in the following sections.

b. Embankment:

- (1) Crest: On the date of inspection, the embankment crest had a dense cover of brush and weeds.

Access across the crest was by foot path. At the right end, near Township Road 532, there were wheel ruts that impounded water to a depth of six to eight inches. At the left end, near the principal spillway training wall, there was a stand of trees with diameters of five to six inches.

The crest was observed to sag toward the center of the embankment, and was found by stadia survey to be 0.7 foot lower at the center than near the spillway training wall.

The crest's horizontal alignment was straight across the right two thirds of the embankment, but curved slightly upstream toward the principal spillway training wall.

Close observation of the crest for surface cracks was not possible because of the heavy vegetal cover.

(2) Upstream Slope: The embankment's upstream slope had a dense cover of brush and weeds making close observation impossible. Traces of riprap (18 inch maximum size) were observed at several locations on the slope but there was no general cover of erosion protection materials.

(3) Downstream Slope: The embankment's downstream slope also had a dense cover of brush and weeds. In addition, piles of cuttings and debris remained on the slope from recent tree cutting operations.

The denseness of the vegetation made a general observation of the downstream slope impossible. Consequently, four inspection paths were machette cut down the slope at 50 foot stations across the crest.

The slope was found to have two steep segments separated by a flatter segment that resembled a bench, located about two thirds of the way down the embankment slope. Soils above the "bench" were observed to be softer (as determined by finger penetration) than soils below the "bench." No wet or seeping conditions were observed on the upper slope or "bench" and no scarps, cracks or local bulges were noted on the embankment.

A wet zone was observed on the lower slope along the right groin, just above the lower lake level. The wet zone was 10 feet long, 20 feet wide and rose about four feet above the lower lake level. No springs, discolored flows or sediment accumulations were observed at or near the wet zone.

c. Groins (Junction of Embankment and Abutment):

(1) Right: No seepage or erosion was observed in or near the right groin along the embankment's upper slope and "bench". The groin passed through the previously noted wet zone on the embankment's lower slope.

(2) Left: The embankment's left groin was also dry and uneroded on the upper part of the embankment.

An old depression or sinkhole was observed near the "bench". The depression was approximately four feet in diameter, about six inches deep and was located immediately above a wet zone located just above the lower lake level. The depression appeared to be rock lined. No evidence of sediment deposition was noted in and around the wet zone below.

d. Abutments:

(1) Right: The right abutment contains Township Road 532, a two lane, asphalt covered roadway. The abutment is generally steep and heavily wooded, both above and below the roadway.

(2) Left: The lower left abutment is the principal spillway channel bank. In the reach at and below the spillway weir wall, the slope is steep, consisting of a very broken bedrock outcrop. Above, the abutment flattens to a moderately steep slope which is densely wooded.

e. Outlet Works: The only visible evidence of an outlet works facility was a steel plate covered masonry structure at the toe of the embankment. The structure was partially inundated by the lower lake. A (valve) stem and associated bracing, all badly bent, were observed inside the structure; operation was not possible.

f. Principal (Ungated) Spillway:

(1) General Configuration: The principal spillway for Star Junction No. 2 dam is an ungated, free overfall weir structure with an embankment side training wall. The spillway is located on the left abutment and was intended to maintain the lake level and to provide discharge capacity for normal and storm flows.

(2) Approach Channel: On 14 November 1979 the approach channel was badly silted in and overgrown with weeds. The abutment slope in the approach channel area was littered with debris including logs and rocks. Flow approached the weir through a small channel. No major obstructions to flow in the approach channel were observed.

(3) Weir and Training Wall: The flow controlling weir consists of a masonry wall capped with a one foot thick layer of concrete (three feet wide). The crest length was observed to be 41 feet, and the downstream drop varies between four and five feet.

The weir wall is attached to the masonry training wall that protects the left end of the earth embankment. Below the weir, the approach channel training wall becomes a masonry retaining wall that protects an earthen training dike.

Both the weir and walls are badly deteriorated with wide joint openings and numerous collapsed areas. A particularly distressed segment of the retaining wall exists just below the weir wall, where the wall has been undercut and is in an advanced state of collapse. The weir has been undercut and lake outflow is beneath the wall rather than over the crest.

(4) Discharge Channel: The principal spillway discharge channel is founded on bedrock for about 90 feet below the weir wall. The bottom is very rough and broken. The right side slope is earth, steep, eroded and tree covered. A peninsula of land juts into the channel 40 feet below the weir, significantly decreasing the channel's cross section.

The left side slope is rock, consisting of a very rough and broken outcrop. Near the lower end of the channel, considerable seepage (10-15 gpm) is exiting through the outcrop. The source of the seepage was not determined but may have been natural subsurface drainage from the hillside above.

The lower end of the channel, above the confluence with the lower lake, was overgrown with brush and small trees.

The channel bottom slope was hand leveled and found to be 0.20 feet/foot (20%) in the reach between the weir and the peninsula, 0.158 feet/foot (15.8%) through the

peninsula constriction, and 0.065 feet/foot (6.5%) in the succeeding 60 feet. The total drop between lakes was 18.4 feet.

g. Instrumentation: No instrumentation was observed during the inspections.

h. Downstream Conditions:

(1) Toe Area: The toe area of Star Junction No. 2 dam is inundated to a depth of about eight feet by the reservoir impounded by Star Junction No. 1 dam.

(2) Channel: Star Junction No. 1 dam lies 1200 feet downstream of Star Junction No. 2 dam. The No. 1 dam spillway is an ungated, free overfall weir structure on the right abutment. The weir width of No. 1 dam varies from 24.5 feet at the base to 35.2 feet at the top of the embankment side training wall. The No. 1 dam crest length is 543 feet, including spillway and wingwall.

(3) Flood Plain Development: At least thirteen inhabited dwellings lie on the flood plain in the first 2000 feet below No. 1 dam. At about 3000 feet below the dam, the creek joins Washington Run and parallels Pennsylvania State Route 51, a major north-south highway. About 1.6 miles downstream, Washington Run turns 90° to the east, and passes through the Borough of Perryopolis.

1. Reservoir:

(1) Shoreline: The reservoir shoreline was moderately to densely tree covered and was observed to be moderately steep. No serious bank erosion was observed.

(2) Inflow Stream: The principal inflow stream enters the upper end of the reservoir through a winding channel across a swampy, deltaic development. The inlet area was covered with small trees, brush and weeds on the date of inspection.

(3) Watershed: The watershed contributing to Star Junction No. 2 dam was observed to be relatively steep, consisting primarily of pasture and woodland. No active or abandoned mining facilities or major construction sites were observed in the watershed.

3.2 EVALUATION

a. Embankment: The general overall condition of the embankment is assessed to be poor, based on limited field observations.

The dense brush, weeds and small trees made it impossible to perform a close observation of all portions of the crest and upstream and downstream slopes. However, no scarps or local bulges were observed and no major misalignments were evident. The downstream slope was found to be non-uniform in cross section, having a pronounced flattening or "bench" on the lower part of the slope. Observed soil firmness below the "bench" and lack of seeps and indications of sloughing, suggest that the non-uniformity is not related to a general movement (creep) of the embankment toe. However, this assessment could not be confirmed by visual observations.

The two wet areas at either side of the embankment did not appear to be serious problems. No significant seepage or movement of soil materials was observed. The depression or sinkhole in the left groin was suspicious, and could not be explained based on field observations. However, it did not appear to be an active or recent phenomenon.

b. Outlet Works: Visual observations were insufficient to determine the condition or even the existence of the outlet works facility. No mechanism or device for upstream flow control was observed.

c. Principal Spillway: The condition of the principal spillway was assessed to be very poor. The generally deteriorated state of the weir wall and retaining wall suggests that large or extended discharge conditions could lead to failure of the spillway facility and subsequent, possible erosion of the left end of the embankment.

SECTION 4 OPERATIONAL FEATURES

4.1 PROCEDURE

The reservoir pool level is normally maintained by the uncontrolled weir wall of the principal spillway. Normal operation does not require a dam tender. The only operational feature of the dam is the reported 8 inch cast iron pipe. The apparent downstream flow control device for the pipeline appears to be inoperable.

4.2 MAINTENANCE OF DAM

No planned maintenance schedule is on record. Observations indicate that maintenance procedures are poor.

4.3 MAINTENANCE OF OPERATING FACILITIES

The operating facility is not maintained.

4.4 WARNING SYSTEM

There is no known warning system or formal emergency procedure to alert and evacuate downstream residents upon threat of a dam failure.

4.5 EVALUATION

Maintenance of the dam and appurtenances is assessed to be poor. The recommendations presented in Section 7 should be implemented as part of a general maintenance and surveillance program at the dam.

SECTION 5
HYDROLOGY AND HYDRAULICS

5.1 EVALUATION OF FEATURES

a. Design Data: The Star Junction No. 2 dam has a watershed of 493 acres which is vegetated primarily by woodland and pasture. The watershed is about one and one half miles long, one half mile wide and has a maximum elevation of 1,400 feet above Mean Sea Level (MSL). At normal pool, the dam impounds a reservoir with a surface area of 6 acres and a storage volume of 31 acre-feet. Normal pool level is maintained at Elev. 1064.9 by the spillway weir wall.

Design spillway capacity and embankment freeboard were made sufficient to accommodate 400 cubic feet per second per square mile which was considered sufficient for this structure and watershed at the time of design. The Star Junction No. 2 dam spillway capacity for the observed cross section and existing freeboard condition was computed to be 969 cfs. No additional hydrologic calculations were found relating reservoir/spillway performance to the Probable Maximum Flood or fractions thereof.

b. Experience Data: Continuous records of reservoir level or rainfall amounts are not kept. There is no record or report of the embankment being overtopped. However, there was a recorded depth of water of 3.3 feet above the crest of the weir during the storm of 4 June 1941. According to the report that stage corresponded to a spillway discharge of 730 cfs.

c. Visual Observations: On the date of the field reconnaissance, severe deterioration of the retaining wall as well as the weir wall was observed. For the purpose of analysis, it was assumed that the weir wall was intact.

d. Overtopping Potential: Overtopping potential was investigated through the development of the Probable Maximum Flood (PMF) for the watershed and the subsequent routing of the PMF and fractions of the PMF through the reservoir and spillway. The Corps of Engineers guidelines recommend 0.5 to 1 times the PMF for "small" size, "high" hazard dams. Based on the observed downstream conditions, Star Junction No. 2 dam has a Spillway Design Flood (SDF) of one PMF.

Hydrometeorological Report No. 33 indicates the adjusted 24 hour Probable Maximum Precipitation (PMP) for the subject site is 19.4 inches. No calculations are available to indicate whether the reservoir and spillway are sized to pass a flood corresponding to 19.4 inches of rainfall in 24 hours. Consequently, an evaluation of the reservoir/spillway system was performed to determine whether the spillway capacity is adequate under current Corps of Engineers guidelines.

The Corps of Engineers, Baltimore District, has directed that the HEC-1 Dam Safety Version computer program be utilized. The program was prepared by the Hydrologic Engineering Center (HEC), U.S. Army Corps of Engineers, Davis, California. The major methodologies and key input data for this program are discussed briefly in Appendix D.

The peak inflow to Star Junction No. 2 dam for the SDF was determined by HEC-1 to be 2256 cfs.

e. Spillway Adequacy: The capacity of the combined reservoir and spillway system was determined to be 0.45 PMF using HEC-1. An initial pool elevation of 1064.9 was assumed prior to commencement of the storm. According to Corps of Engineers' guidelines, Star Junction No. 2 dam's spillway is "inadequate."

At 0.50 PMF, No. 2 dam is overtopped by 0.27 feet of water for 65 minutes. In the opinion of the evaluating engineer, this overtopping would not cause a failure of the embankment. This is based on the computed flow depth and duration data, and soil type, soil firmness and vegetal cover conditions. An overtopping depth of at least one foot above the minimum elevation of the dam was judged by the engineer to be necessary to cause failure of the dam. Consequently, a downstream routing and breach analysis were not performed.

Therefore, in accordance with Corps of Engineers guidelines, the spillway is rated as "inadequate" but not "seriously inadequate".

SECTION 6 STRUCTURAL STABILITY

6.1 AVAILABLE INFORMATION

a. Design and Construction Data: All available design documentation, calculations and other data received from the Pennsylvania Department of Environmental Resources were reviewed. This data is discussed in Section 2 and a detailed listing is included in Appendix B. Selected items are presented in Appendix E.

b. Operating Records: There are no written operating records or procedures for this dam.

6.2 EVALUATION

a. Design Documents: The design documentation was, by itself, considered inadequate to evaluate the structure. There were no structural calculations associated with the stability of the embankment or of the appurtenant structures.

b. Visual Observations:

(1) Embankment: The field inspection disclosed no strong evidence of potential instability of the embankment or its components. However, thick brush and debris limited the visual observations of the downstream slope. The embankment's non-uniform cross-section may be an indication of long-term movement (creep) of the embankment, but this is not believed to be the case. This is based on observed soil firmness and absence of supporting evidence of instability. However, stability of the structure during high reservoir pool conditions is questionable.

(2) Seepage: The wet zones on the slope near the intersection of the embankment and the No. 1 dam reservoir below are of some concern. However, their existence has been known for years, and the visual observations of the Phase I inspection revealed no indications of piping or movement of soil fines.

(3) Principal Spillway: The principal spillway weir wall and training dike were observed to be undercut and in a state of collapse. Based on the field observations, both facilities are assessed to have very questionable structural integrity.

c. Performance: Star Junction No. 2 dam and reservoir have been periodically inspected over the 79 year life of the structure by Water and Power Resources Board and later PennDER personnel. Twelve inspection reports are on file for the period between 17 June 1916 and 26 July 1961. Several of the reports note the existence of seepage and wet zones beginning on 17 June 1926. On 20 June 1934, a small landslide was observed about half way up the slope near the right end of the embankment. Some seepage was noted below this slide. No indication was found in the PennDER files of correction or repair of the distress.

d. Seismic Stability: According to the Seismic Risk Map of the United States, Star Junction No. 2 dam is located in Zone 1 where damage due to earthquakes would most likely be minor.

A dam located in Seismic Zone 1 may be assumed to present no hazard from an earthquake provided static stability conditions are satisfactory and conventional safety margins exist. Since there is concern regarding the static stability of the embankment, the seismic stability is questionable and should be assessed as part of the investigations recommended in Section 7.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS

7.1 ASSESSMENT

a. Evaluation.

(1) Embankment: Star Junction No. 2 dam's embankment is assessed to be in poor condition. This is based on visual observations of slope non-uniformities, wet conditions and state inspection reports.

The inability to closely inspect the crest, downstream slope, groins, and abutments due to dense brush, weeds, trees and debris is considered to be a deficiency.

The upstream slope erosion protection (riprap) was observed to be in poor condition.

The wheel rutting and ponded water on the embankment crest is considered to be a deficiency.

(2) Outlet Works: The condition of the reported eight inch cast iron outlet pipe could not be determined. The downstream control was observed to be damaged and probably is not operable. No control or mechanism was observed to permit upstream flow control.

(3) Principal Spillway: The principal spillway is assessed to be in very poor condition. This is based on visual observations of the weir wall and training dike retaining wall. Both structures are partially collapsed and badly deteriorated and safe performance is questionable in the event of long-term, high discharge conditions.

(4) Flood Discharge Capacity: The principal spillway flow discharge capacity is assessed to be "inadequate." This is based on hydrologic/hydraulic computations using the HEC-1 Dam Safety Version computer program, that indicated the existing reservoir/spillway system is capable of passing 0.45 PMF. At 0.5 PMF, the embankment is overtopped by a maximum 0.27 feet for 65 minutes. In the opinion of the evaluating engineer, this amount of overtopping is not sufficient to cause failure of the embankment.

(5) Downstream Conditions: Based on the results of the visual observations and the hydrologic/hydraulic computations, the lack of an emergency warning and operation plan is considered to be a deficiency.

b. Adequacy of Information. The available information and the observations made during field inspections of the dam are considered sufficient for purposes of the Phase I inspection report.

c. Urgency. The inspection indicated the existence of a deficiency which may have reduced the structural stability of the spillway to an unacceptable level. This deficiency, collapse and severe deterioration of the spillway weir wall and embankment retaining wall, should be investigated and corrected immediately.

d. Necessity for Additional Data/Evaluation. Additional engineering information is required to adequately evaluate and improve the structural stability of the facilities.

7.2 RECOMMENDATIONS

a. Additional Investigations. It is recommended that the owner immediately retain the services of a registered professional engineer knowledgeable and experienced in the design and construction of earth dams and masonry spillways to provide a detailed engineering investigation of Star Junction No. 2 dam. This investigation should include but not be limited to the following:

(1) Detailed evaluation of spillway capacity and stability and development of recommendations for remedial action.

(2) Detailed investigation of the seepage and wet conditions and structural stability of the embankment.

(3) Investigation of the outlet works with specific recommendations on making it operable and including provisions for upstream flow control.

b. Emergency Operation and Warning Plan. Concurrent with the additional investigations recommended above, the owner should develop an Emergency Operation and Warning Plan including:

(1) Guidelines for evaluating inflow during periods of heavy precipitation or runoff.

(2) Procedures for around the clock surveillance during periods of heavy precipitation or runoff.

(3) Procedures for rapid drawdown of the reservoir under emergency conditions.

(4) Procedures for notifying downstream residents and public officials, in case evacuation of downstream areas is necessary.

c. Remedial Work. The Phase I Inspection of Star Junction No. 2 dam also disclosed several deficiencies of lower priority which should be corrected immediately.

(1) Closely mow the embankment slopes, crest, groins, abutments and immediate downstream areas. Remove the cuttings from the site.

(2) Locate and backfill completely, all animal burrows on the embankment, groins and adjacent abutment areas.

(3) Replace lost riprap along the upstream slope of the embankment.

(4) Fill wheel ruts and minor erosion gullies on the embankment and adjacent areas.

(5) Raise the embankment crest to design elevation.

(6) Remove boulders, trees, down timber and debris from the principal spillway approach and discharge channel.

(7) Develop and implement formal maintenance and inspection procedures.

d. Orderly Breaching: In lieu of performing the above recommendations, the owner should engage the services of a professional engineer, knowledgeable in dam design and performance, to prepare specifications for breaching the structure, to make it incapable of impounding water. The structure should then be breached under the direction of the professional engineer and in accordance with applicable state and local regulations.

APPENDIX A
VISUAL INSPECTION CHECKLIST

VISUAL OBSERVATIONS CHECKLIST I
NON-MASONRY IMPOUNDING STRUCTURE

Name Dam Star Junction No. 2 County Fayette State Pennsylvania National ID # PA 00212

Type of Dam Earthfill Hazard Category High

Date (s) Inspection 14 November 1979 Weather Overcast, cool Temperature 36°F

Pool Elevation at Time of Inspection 1064.9 (MSL) Tailwater at Time of Inspection 1060+(MSL)

Inspection Personnel: J. E. Barrick, P.E. Ackenheil & Associates, Hydrologist and Project Manager.
J. P. Hannan Ackenheil & Associates, Geotechnical Engineer
S. G. Mazzella Ackenheil & Associates, Civil Engineer
J. B. Zeppieri Ackenheil & Associates, Geologist
L. D. Busack PennDER Bureau of Dams and Waterways Management, Regional Hydraulic Engineer (Present only for initial site visit, 7 November 1979)

Recorder J. E. Barrick

GEO Project G79153-J
PennDER I.D. No. 26-31

EMBANKMENT

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
SURFACE CRACKS	None observed on crest or visible portions of upstream slopes. Vehicle wheel ruts exist at right end of embankment crest and impound water to a depth of 6 to 8 inches. Embankment crest heavily vegetated, access via footpath. Stand of 5 to 6 inch diameter trees on left end of embankment near spillway.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed. Downstream toe of embankment inundated by reservoir pool from Star Junction No. 1 Dam.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None observed on embankment or right abutment slope. Left abutment slope which constitutes the left slope of the principal spillway has moderate amount of sloughing, erosion and collapse of bedrock.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	The embankment crest rises slightly to the right where it approaches Township Road Number 532 and to the left near the principal spillway. Horizontal alignment of embankment crest is approximately straight beginning at the right abutment. Proceeding toward the left, at approximately 200 feet from the Township Road, the crest turns slightly toward the upstream where it connects with the stone training wall of the principal spillway.	
RIPRAP FAILURES	Traces of riprap are evident on the embankment upstream slope at and just above the waterline. Estimated rock size approximately 18 inches. Locations of riprap are sporadic, riprap above the waterline is overgrown with vegetation. General condition very poor.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SETTLEMENT	None observed.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Right groin, embankment and abutment heavily overgrown with weeds and brush. No erosion or seepage apparent. Left abutment of embankment has similar condition. No seepage or erosion apparent. Junction of spillway and dam consists of a stone and mortar training wall 40 feet long that constitutes the right side of the principal spillway. The wall is generally deteriorating with large gaps in the mortar. In the area immediately below the principal spillway weir, erosion of the wall foundation has occurred. The wall is collapsing with large settlements observed.	
ANY NOTICEABLE SEEPAGE	Two wet spots observed in the vicinity of the downstream toe. The first wet spot exists near the junction of the right groin and the lower reservoir. The wet spot is approximately 20 feet wide, 10 feet long and rises to an elevation approximately 4 feet above the level of the lower reservoir. On the left in an approximately similar position near the junction of the groin near the lower reservoir a smaller wet spot exists. This area is approximately 5 feet square and extends to an elevation of approximately 2 feet above the lower reservoir. A large spring exists in the lower portion of the principal spillway discharge channel approximately 40 to 50 feet above the confluence of the spillway channel and the lower reservoir. This spring is discharging through the cracks in bedrock on the abutment side of the spillway and is discharging an estimated 10 to 15 gallons per minute, clear water. No evidence of siltation in the general vicinity of the spring.	
STAFF GAGE AND RECORDER	None observed.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
DRAINS	None observed.	
DOWNSTREAM SLOPE INSPECTION	<p>Stations are referenced from right end of embankment. Station 0+50. Surface material is moist and generally quite loose, penetrated easily by fingers. Heavily brush covered, very difficult to observe. Below bench, material penetrated by finger with difficulty. Station 1+00. Approximate similar condition. Softer material generally tends to be above the bench. Below the bench it firms up. Station 1+50. Softness and moss evident approximately halfway down the slope, soil is moist, not wet, no seeping water apparent. Again, material firms up below bench. Station 2+00. Trees at crest, dense pile of brush and down timber on slope. Impossible to traverse line along Station 2+00. From crest, slope conditions appear similar to Station 1+50. Depression near downstream toe of embankment approximately Station 1+90, approximately on same line as outlet works box, depression in the ground at or near the groin of the embankment, approximately 6 inches deep, 4 feet circular section. No seeping water, no apparent sign of erosion, depression seems to be part of a drainage swale which apparently has no outlet. Depression is located approximately 4 to 4.5 feet below the elevation of the bench. Depression seems to be rockfilled. No evidence below of silting due to movement of fines out of this area. Depression is moss covered, heavily overgrown with weeds. Evidences exist of a formerly rocklined groin passing through the depression.</p>	

OUTLET WORKS

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	None observed.	
INTAKE STRUCTURE	None observed.	
OUTLET STRUCTURE		An apparent outlet structure exists at the toe of the embankment approximately halfway across the dam. The structure is constructed of stone and mortar and is inundated by the pool of Star Junction No. 1 dam to within 9 inches of the top of the structure. The structure is covered with a steel plate and contains what appears to be a valve stem and associated bracing. Both the bracing and the stem are badly bent and appear to be inoperable.
OUTLET CHANNEL	Not applicable.	
EMERGENCY GATE	Not observed.	

PRINCIPAL (UNGATED) SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	<p>The principal (ungated) spillway overflow control weir consists of a mortar and stone wall capped with approximately one foot of concrete. The length of the structure is 41 feet and the width is approximately 3 feet. The stone and mortar wall has disintegrated completely and has collapsed at the central portion of the weir. The concrete cap is badly spalled and corroded and has disappeared in the area of the right abutment. Outflow from the reservoir has undercut the weir structure and is flowing beneath and through the stone rubble remnants of the masonry wall. The approximate height of the weir is 4 to 5 feet.</p>	
APPROACH CHANNEL	<p>Sedimented, overgrown with weeds and brush. Channel slopes are littered with debris including logs and rocks.</p>	
DISCHARGE CHANNEL	<p>The discharge channel has been cut into rock below the overflow weir. The right slope is sloughing and bedrock slopes are collapsing into the channel. Trees adjacent to the channel are tilted and colluvium deposits exist at the base of the slope. On the right side below the training wall the slope is very steep and eroded. Approximately 40 feet below the weir, the channel narrows considerably as the result of a peninsula of land jutting from the right side of the spillway. The base width of the channel in this vicinity is approximately 10 feet. At this point the slope of the channel drops sharply and turns approximately 30 degrees to the right on its approach to the lower reservoir. The channel bottom is strewn with large boulders. Embankment slopes are undercut, and heavily brush and tree covered.</p>	
BRIDGE AND PIERS	<p>None observed.</p>	

DOWNSTREAM CHANNEL

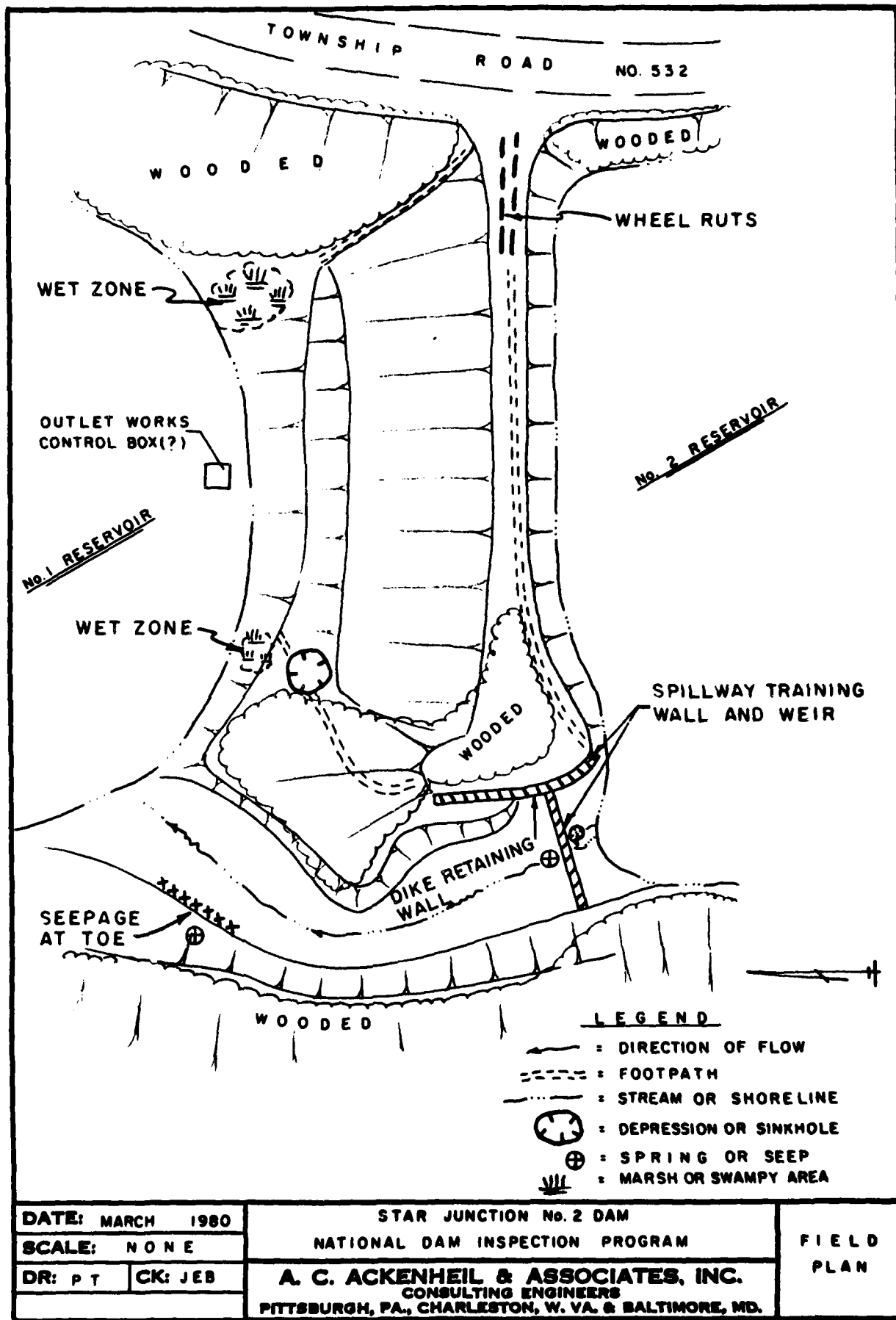
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Discharge channel described under principal spillway above. No downstream channel exists. Discharge flows into reservoir of Star Junction No. 1 dam.	
SLOPES	Not applicable.	
APPROXIMATE NO. OF HOMES AND POPULATION	Below Star Junction No. 1 dam are several inhabited dwellings located on lowest terrace of flood plain in the first 2000 foot reach below the embankment. A major highway (PA State Route 51) parallels the creek for more than 1 mile beginning about 3000 feet below the embankment.	

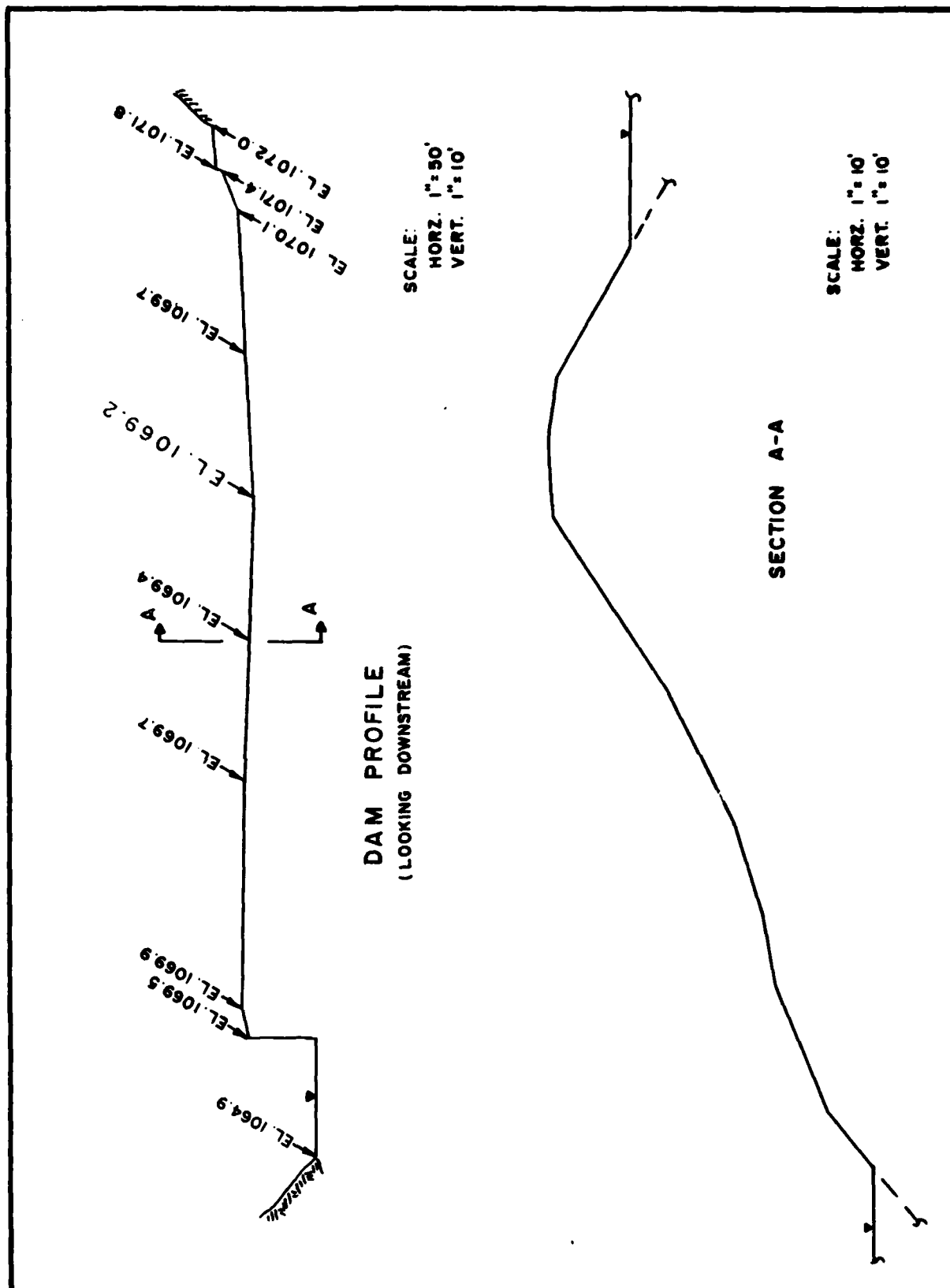
INSTRUMENTATION

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
MONUMENTATION/SURVEYS	None observed.	
OBSERVATION WELLS	None observed.	
WEIRS	None observed.	
PIEZOMETERS	None observed.	
OTHER	None observed.	

RESERVOIR

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
<u>SLOPES</u>	Reservoir slopes are generally steep. Approximately one vertical to three horizontal over the entire perimeter with the exception of the upstream end where the inflow channel approaches the reservoir. The inflow channel is a small winding stream and the valley is brush, tree and weed clogged. The area at the upper end of the reservoir appears to be swampy with vegetation growing, probably on sedimented materials.	
<u>SEDIMENTATION</u>	Other than the sedimentation indicated above, no serious signs of sedimentation are evident in the reservoir. As mentioned previously, the approach channel to the principal spillway contains a considerable amount of sediment.	





DATE: MARCH 1980		STAR JUNCTION No.2 DAM		FIELD PROFILE AND SECTION
SCALE: AS SHOWN		NATIONAL DAM INSPECTION PROGRAM		
DR: JF	CK: JEB	A. C. ACKENHEIL & ASSOCIATES, INC.		
		CONSULTING ENGINEERS		
		PITTSBURGH, PA., CHARLESTON, W. VA. & BALTIMORE, MD.		

APPENDIX B
ENGINEERING DATA CHECKLIST

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Star Junction No. 2
I.D. No. PA 00212

ITEM	REMARKS
*Design Drawings	Design drawings by Thomas M. Zimmerman, Dawson, Pennsylvania including: "Plan of Reservoir No. 2, Washington Coal and Coke Company, Star Junction", October 1900. "Plan and sections of Washington Coal and Coke Company's No. 2 Reservoir Dam showing proposed change on dam and spillway", June 1915.
As-Built Drawings	None available.
Regional Vicinity Map	USGS 7-1/2 Minute Fayette City Quadrangle
*Construction History	Constructed by Washington Coal and Coke Company under direction of Thomas M. Zimmerman in 1900 and 1901.
*Typical Sections of Dam	See Design Drawings above.
Outlets - Plans Details Constraints	None available.
Outlet Discharge Ratings	None available.
Rainfall/Reservoir Records	None recorded.

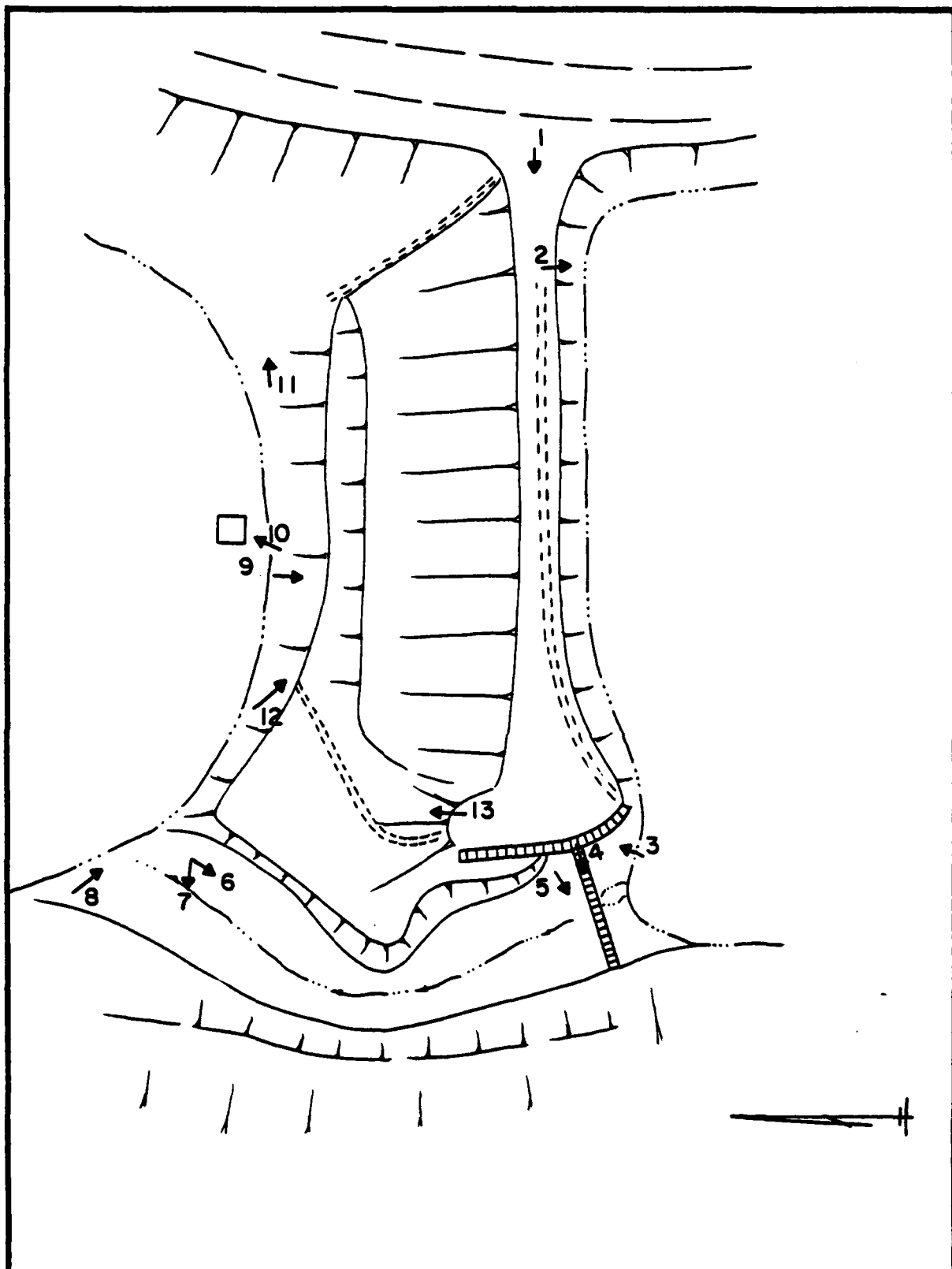
ITEM	REMARKS
Design Report	See "Report on Dam No.2 of the Washington Coke and Coal Company" dated 7 January 1915.
Geology Report	None available.
Hydrology and Hydraulic	None available.
Design Computations Dam Stability Seepage Studies	None available.
Materials Investigations Boring Records Laboratory Field	None available.
Post-Construction Surveys of Dam	None reported.
Borrow Sources	Data not available.
Monitoring Systems	None reported.
Modifications	See Design Drawings above and Design Report above.
High Pool Records	See correspondence dated 19 January 1951 regarding flood of 4 June 1941.
Post-Construction Engineering Studies and Reports	Twelve site inspection reports by State of Pennsylvania personnel between 17 June 1916 and 26 July 1961.

ITEM	REMARKS
Prior Accidents or Failure of Dam Description Reports	State inspection report dated 20 June 1934 noted small slide half way up the embankment slope near the right side.
Maintenance Operation Records	None available.
Spillway - Plan Section Details	See Design Drawings above.
Specifications	None available.

* Information and data may be obtained from the Pennsylvania Department of Environmental Resources, Harrisburg, Pennsylvania.

** Reduced size reproductions contained in Appendix E.

APPENDIX C
PHOTOGRAPHS



DATE: MARCH 1980

SCALE: NONE

DR: PT **CK:** JEB

STAR JUNCTION No. 2 DAM

NATIONAL DAM INSPECTION PROGRAM

A. C. ACKENHEIL & ASSOCIATES, INC.
CONSULTING ENGINEERS
PITTSBURGH, PA., CHARLESTON, W. VA. & BALTIMORE, MD.

**PHOTO
KEY
MAP**

STAR JUNCTION No.2 DAM



PHOTO 1. VIEW OF EMBANKMENT CREST



PHOTO 2. RIPRAP ON UPSTREAM SLOPE

STAR JUNCTION No.2 DAM



PHOTO 3. SPILLWAY TRAINING WALL AND APPROACH CHANNEL



PHOTO 4. OVERVIEW OF SPILLWAY WEIR

STAR JUNCTION No.2 DAM



PHOTO 5. CLOSE-UP OF SPILLWAY WEIR BASE



PHOTO 6. UPSTREAM VIEW OF LOWER SPILLWAY
DISCHARGE CHANNEL

STAR JUNCTION No.2 DAM



PHOTO 7. SEEPAGE AT TOE OF LEFT SLOPE
OF DISCHARGE CHANNEL



PHOTO 8. OVERVIEW OF DOWNSTREAM SLOPE

STAR JUNCTION No.2 DAM

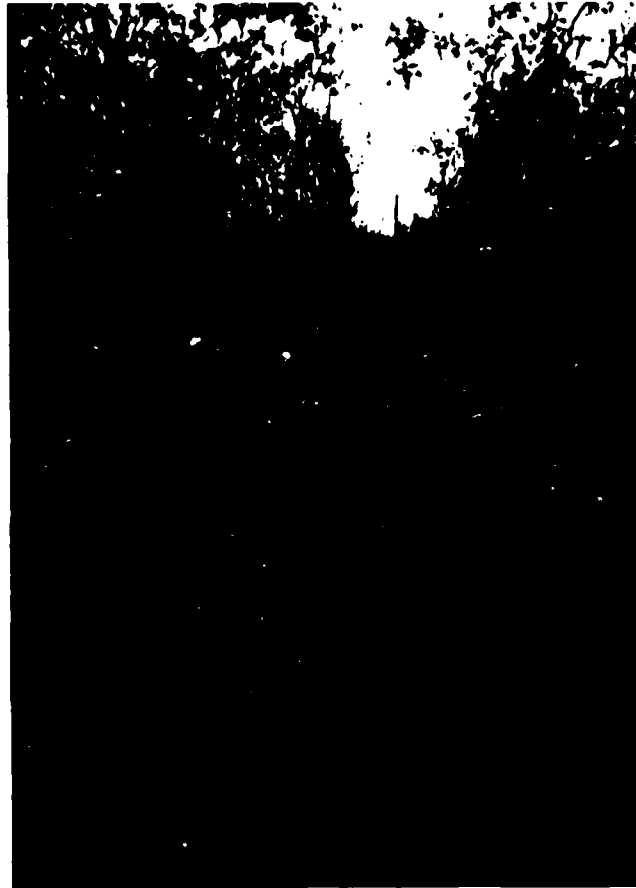


PHOTO 9. DENSE BRUSH ON DOWNSTREAM SLOPE

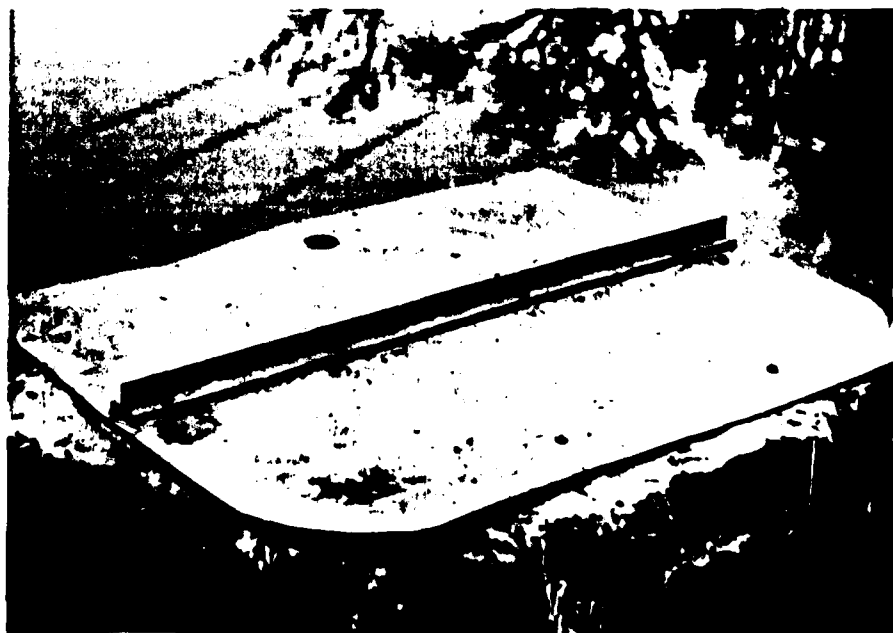


PHOTO 10. CLOSE-UP OF OUTLET WORKS CONTROL BOX

STAR JUNCTION No. 2 DAM

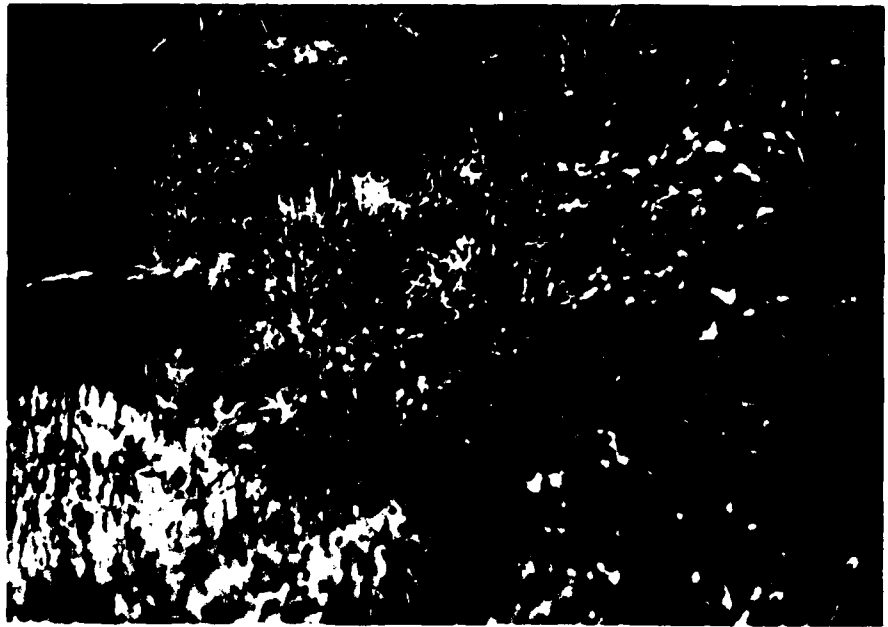


PHOTO 11. WET ZONE IN LOWER RIGHT GROIN

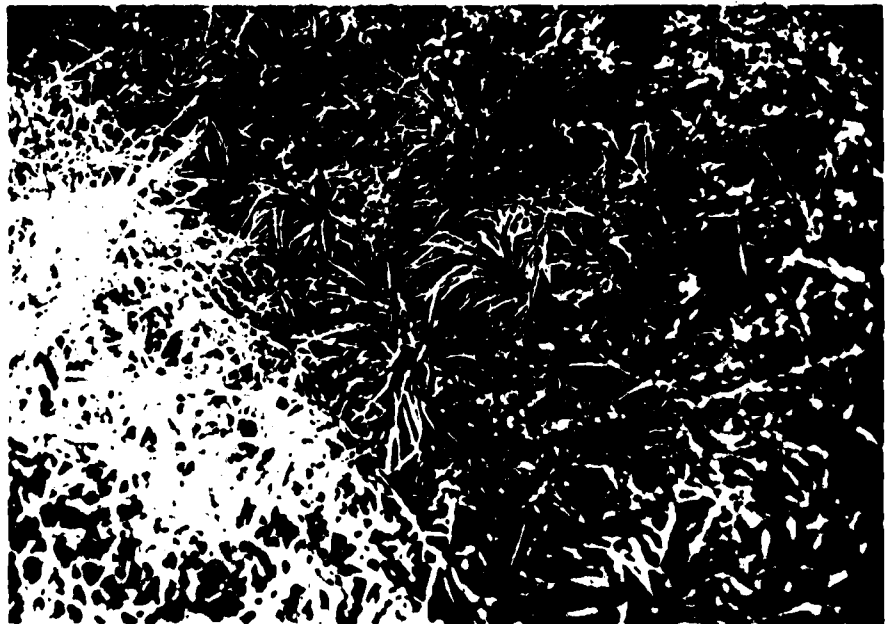


PHOTO 12. WET ZONE IN LOWER LEFT GROIN

STAR JUNCTION No 2 DAM



PHOTO 13 VIEW OF STAR JUNCTION No. 1 DAM
AND RESERVOIR



PHOTO 14. OVERVIEW OF STAR JUNCTION No. 1 DAM

DETAILED PHOTO DESCRIPTIONS

- Photo 1 View of Embankment Crest from right abutment.
Note wheel ruts, ponded water, and trees and bushes growing on embankment.
- Photo 2 Riprap on Upstream Slope with small trees and bush growing among the riprap.
- Photo 3 Spillway Training Wall and Approach Channel.
Note subsidence at center of wall and sedimentation of spillway approach channel.
- Photo 4 Overview of Spillway Weir. Note collapsed base downstream (right), and upstream sinkhole.
- Photo 5 Close-up of Spillway Weir Base showing the deteriorated concrete cap and sandstone block wall.
- Photo 6 Upstream View of Lower Spillway Discharge Channel.
- Photo 7 Seepage at Toe of Left Slope of Discharge Channel.
- Photo 8 Overview of Downstream Slope showing submerged outlet works control box. Photo taken from downstream end of spillway discharge channel.
- Photo 9 Dense Brush on Downstream Slope. Machette cut inspection path shown.
- Photo 10 Close-up of Outlet Works Control Box at toe of embankment.
- Photo 11 Wet Zone in Lower Right Groin.
- Photo 12 Wet Zone in Lower Left Groin.
- Photo 13 View of Star Junction No. 1 Dam and Reservoir from the embankment crest of Star Junction No. 2 dam.
- Photo 14 Overview of Star Junction No. 1 Dam downstream of No. 2 Dam.

APPENDIX D
HYDROLOGY AND HYDRAULICS
ANALYSES

APPENDIX D HYDROLOGY AND HYDRAULICS

Methodology: The dam overtopping analysis was accomplished using the systemized computer program HEC-1 (Dam Safety Version, July 1978), prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. A brief description of the methodology used in the analysis is presented below.

1. Precipitation: The Probable Maximum Precipitation (PMP) is derived and determined from regional charts prepared from past rainfall records including "Hydrometeorological Report No. 33" prepared by the U.S. Weather Bureau.

The index rainfall is reduced from 10% to 20% depending on watershed size by utilization of what is termed the HOP Brook adjustment factor. Distribution of the total rainfall is made by the computer program using distribution methods developed by the Corps.

2. Inflow Hydrograph: The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for reservoir routing.

The unit hydrograph is developed using the Snyder method. This method requires calculation of several key parameters. The following list gives these parameters, their definition and how they were obtained for these analyses.

<u>Parameter</u>	<u>Definition</u>	<u>Where Obtained</u>
Ct	Coefficient representing variations of watershed	From Corps of Engineers
L	Length of main stream channel	From U.S.G.S. 7.5 minute topographic map
Lca	Length on main stream to centroid of watershed	From U.S.G.S. 7.5 minute topographic map

Cp	Peaking coefficient	From Corps of Engineers
A	Watershed size	From U.S.G.S. 7.5 minute topographic map

3. Routing: Reservoir routing is accomplished by using Modified Puls routing techniques where the flood hydrograph is routed through reservoir storage. Hydraulic capacities of the outlet works, spillways and the crest of the dam are used as outlet controls in the routing.

The hydraulic capacity of the outlet works can either be calculated and input or sufficient dimensions input and the program will calculate an elevation-discharge relationship.

Storage in the pool area is defined by an area-elevation relationship from which the computer calculates storage. Surface areas are either planimeted from available mapping or U.S.G.S. 7.5 minute series topographic maps or taken from reasonably accurate design data.

4. Dam Overtopping: Using given percentages of the PMF the computer program will calculate the percentage of the PMF which can be controlled by the reservoir and spillway without the dam overtopping.

*Developed by the Corps of Engineers on a regional basis for Pennsylvania.

HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Predominately woodland and pasture.

ELEVATION TOP NORMAL POOL (STORAGE
CAPACITY): 1064.9 (31 acre-ft.)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE
CAPACITY): 1069.2 (59 acre-ft.)

ELEVATION MAXIMUM DESIGN POOL: Design 1069.5

ELEVATION TOP DAM: Design 1069.5, observed minimum 1069.2

OVERFLOW SECTION

- a. Elevation 1064.9
- b. Type Concrete on masonry weir wall
- c. Width 41 feet
- d. Length N/A
- e. Location Spillover Left abutment
- f. Number and Type of Gates None

OUTLET WORKS

- a. Type 8 inch outlet pipe
- b. Location Through dam near centerline
- c. Entrance Inverts Unknown
- d. Exit Inverts Unknown
- e. Emergency Drawdown Facilities None

HYDROMETEOROLOGICAL GAGES

- a. Type None
- b. Location N/A
- c. Records None

MAXIMUM REPORTED NON-DAMAGING DISCHARGE 730 cfs (4 June 1941)

HEC-1 DAM SAFETY VERSION
HYDROLOGY AND HYDRAULIC ANALYSIS
DATA BASE

NAME OF DAM: Star Junction No. 2 Dam	NDI ID NO. PA 212
Probable Maximum Precipitation (PMP)	24.2*
Drainage Area	0.77 sq. mi.
Reduction of PMP Rainfall for Data Fit	0.8 (24.2)
Reduce by 20%, therefore PMP rainfall	=19.4 in.
Adjustments of PMF for Drainage Area (Zone 7)	
6 hrs.	102%
12 hrs.	120%
24 hrs.	130%
Snyder Unit Hydrograph Parameters	
Zone	25**
C _p	0.4
C _t	1.0
L	1.13 mi.
L _{ca}	0.57 mi.
$t_p = C_t (L + L_{ca})^{0.3} =$	0.88 hrs.
Loss Rates	
Initial Loss	1.0 in.
Constant Loss Rate	0.05 in./hr.
Base Flow Generation Parameters	
Flow at Start of Storm	1.5 cfs/sq. mi.=1.16 cfs
Base Flow Cutoff	0.05 x Q peak
Recession Ratio	2.0
Overflow Section Data	
Crest Length	41 ft.
Freeboard	4.3 ft.
Discharge Coefficient	2.65
Exponent	1.5
Discharge Capacity	969 cfs

* Hydrometeorological Report 33

** Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's Coefficients (C_p and C_t).

ACKENHEIL & ASSOCIATES
GEO Systems, Inc.
1000 Banksville Road
PITTSBURGH, PA. 15216
(412) 531-7111

Sheet _____ of _____
Job Star Junction No. 2 Dam Job No. 79/E3D
Subject Data Input
Made By JPH Date 2/21/80 Checked LEB Date 2/29/80

LOSS RATE AND BASE FLOW PARAMETERS

As Recommended by Corps of Engineers, Baltimore District

STRTL = 1 inch
CNSTL = 0.05"/hr.
STRTO = 1.5 CF2/min.²
QRSEN = 0.05 (5% of Peak Flow)
RTIOR = 2.0

ELEVATION - AREA - CAPACITY RELATIONSHIPS - STAR JUNCTION NO. 2 DAM

From U.S.G.S. 7.5 min. Quad, Penn DER Files and Field Inspection Data

At Spillway Crest Elevation = 1064.9'

Initial Storage = 31 Acre-ft.

Pond Surface Area = 6 Acres

At Elevation 1080, Area = 10.1 Acres

At Elevation 1100, Area = 29.4 Acres

From Conic Method for Reservoir Volume
Flood Hydrograph Package (HEC-1)
Dam Safety Version (Users Manual)

$$\begin{aligned} H &= 3V/A \\ &= 3(31)/6 \\ &= 15.5 \text{ Ft.} \end{aligned}$$

Elevation Where Area Equals Zero:
1064.9 - 15.5 = 1049.4 Ft.

AREA	SA	0	6	10.1	29.4
ELEVATION	SE	1049.4	1064.9	1080	1100

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Sheet _____ of _____

Job STAR JUNCTION NO. 2 DAM Job No. 791521

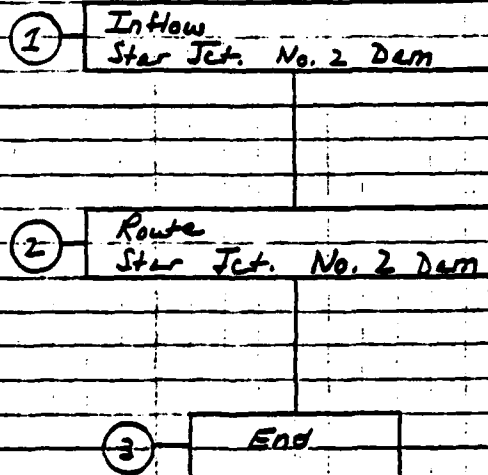
Subject DATA INPUT

Made By LPH Date 2/21/80 Checked JES Date 2/29/80

OVERTOP PARAMETERS

Top of Dam Elev. (Low pt.)	1069.2'
Length of Dam (Excluding Spillway)	200'
Coefficient of Discharge (C)	2.65
$\$L$ MAX	324'
$\$V$ MAX	1074'

PROGRAM SCHEDULE



 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 26 FEB 79

1	A1	NATIONAL PROGRAM FOR THE INSPECTION OF NON-FEDERAL DAMS									
2	A2	HYDROLOGIC AND HYDRAULIC ANALYSIS OF STAR JUNCTION NUMBER 2 DAM									
3	A3	PROBABLE MAXIMUM FLOOD PMF/UNIT HYDROGRAPH BY SNYDERS METHOD									
4	B	300	0	5	0	0	0	0	0	-4	0
5	B1	5									
6	J	1	9	1							
7	J1	1.	0.9	0.8	0.7	0.5	0.4	0.3	0.2	0.1	
8	K	0	1					1			
9	K1	INFLOW HYDROGRAPH FOR NUMBER 2 DAM									
10	M	1	1	0.77	0.77	1				1	
11	P		19.4	102	120	130					
12	T							1.0	0.05		
13	W	0.88	0.40								
14	X	-1.5	-0.05	2.0							
15	K	1	2					1			
16	K1	ROUTING AT NUMBER 2 DAM									
17	Y			1	1						
18	Y1	1						31.			
19	\$A	0.	6.	10.1	29.4						
20	\$E1049.4	1064.9	1080.	1100.							
21	\$S1064.9	41	2.65	1.5							
22	\$D1069.2	2.65	1.5	300							
23	\$L	30.	275.	320.	324.						
24	\$V1069.2	1070.	1072.	1074.							
25	K	99									
26	A										
27	A										
28	A										
29	A										
30	A										

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	1
ROUTE HYDROGRAPH TO	2
END OF NETWORK	

 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 26 FEB 79

RUN DATE: 11 MAR 80
 RUN TIME: 7.34.33

NATIONAL PROGRAM FOR THE INSPECTION OF NON-FEDERAL DAMS
 HYDROLOGIC AND HYDRAULIC ANALYSIS OF STAR JUNCTION NUMBER 2 DAM
 PROBABLE MAXIMUM FLOOD PMF/UNIT HYDROGRAPH BY SNYDERS METHOD

JOB SPECIFICATION									
NQ	MHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	INSTAN
300	0	5	0	0	0	0	0	-4	0
			JOPER	NWT	LROPT	TRACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
 NPLAN= 1 NRTIO= 9 LRTIO= 1
 RTIOS= 1.00 0.90 0.80 0.70 0.50 0.40 0.30 0.20 0.10

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH FOR NUMBER 2 DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA									
INTG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISMOW	ISAME	LOCAL
1	1	0.77	0.0	0.77	1.00	0.0	0	1	0

PRECIP DATA								
SPFE	PMS	R6	R12	R24	R48	R72	R96	
0.0	19.40	102.00	120.00	130.00	0.0	0.0	0.0	

LOSS DATA										
LROPT	SINKR	DLIKR	RTIOL	ERAIN	SINKS	RTIOK	STRIL	CNSTL	ALSHK	RTIMP
0	0.0	0.0	1.00	0.0	0.0	1.00	1.00	0.05	0.0	0.0

UNIT HYDROGRAPH DATA			
TP=	0.88	CP=0.40	NTA= 0

RECESSION DATA			
STRQ=	-1.50	QRCSN= -0.05	RTIOR= 2.00

UNIT HYDROGRAPH 100 END-OF-PERIOD ORDINATES, LAG= 0.88 HOURS, CP= 0.40 VOL= 0.99									
6.	22.	45.	73.	103.	136.	168.	193.	213.	226.
230.	223.	212.	202.	192.	183.	174.	165.	157.	149.
142.	135.	128.	122.	116.	110.	105.	100.	95.	90.
86.	82.	78.	74.	70.	67.	63.	60.	57.	54.
52.	49.	47.	45.	42.	40.	38.	36.	35.	33.
31.	30.	28.	27.	26.	24.	23.	22.	21.	20.
19.	18.	17.	16.	15.	15.	14.	13.	13.	12.
11.	11.	10.	10.	9.	9.	8.	8.	8.	7.
7.	7.	6.	6.	6.	5.	5.	5.	5.	4.
4.	4.	4.	4.	3.	3.	3.	3.	3.	3.

END-OF-PERIOD FLOW													
MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
SUM 25.22 23.34 1.88 136911. (641.)(593.)(48.)(3576.89)													

HYDROGRAPH ROUTING

ROUTING AT NUMBER 2 DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA								
GLOSS	CLOSS	AVG	IRIS	ISAME	IOPT	IPMP	LSTR	
0.0	0.0	0.0	1	1	0	0	0	

NSTPS	NSTIL	LAG	AMSK	X	TSK	STORA	ISPRAT
1	0	0	0.0	0.0	0.0	31.	0

SURFACE AREA=	0.	6.	10.	29.
CAPACITY=	0.	31.	151.	529.
ELEVATION=	1049.	1065.	1080.	1100.

CRIL	SPWID	COGW	EXPW	ELEV	COGL	CAREA	EXPL
1064.9	41.0	2.6	1.5	0.0	0.0	0.0	0.0

DAM DATA			
TOPEL	COGD	EXPD	DAMWID
1069.2	2.6	1.5	300.

CREST LENGTH AT OR BELOW ELEVATION	30.	275.	320.	324.
	1069.2	1070.0	1072.0	1074.0
PEAK OUTFLOW IS	2256.	AT TIME	16.50 HOURS	
PEAK OUTFLOW IS	2029.	AT TIME	16.50 HOURS	
PEAK OUTFLOW IS	1803.	AT TIME	16.50 HOURS	
PEAK OUTFLOW IS	1572.	AT TIME	16.50 HOURS	
PEAK OUTFLOW IS	1090.	AT TIME	16.67 HOURS	
PEAK OUTFLOW IS	860.	AT TIME	16.75 HOURS	
PEAK OUTFLOW IS	641.	AT TIME	16.75 HOURS	
PEAK OUTFLOW IS	424.	AT TIME	16.83 HOURS	
PEAK OUTFLOW IS	208.	AT TIME	16.92 HOURS	

 (PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS								
				RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9
				1.00	0.90	0.80	0.70	0.50	0.40	0.30	0.20	0.10
HYDROGRAPH AT	1	0.77	1	2263.	2036.	1810.	1584.	1131.	905.	679.	453.	226.
	(1.99)	(64.07)(57.66)(51.26)(44.85)(32.04)(25.63)(19.22)(12.81)(6.41)
ROUTED TO	2	0.77	1	2256.	2029.	1803.	1572.	1090.	860.	641.	424.	208.
	(1.99)	(63.88)(57.46)(51.04)(44.52)(30.87)(24.35)(18.15)(12.00)(5.88)

SUMMARY OF DAM SAFETY ANALYSIS

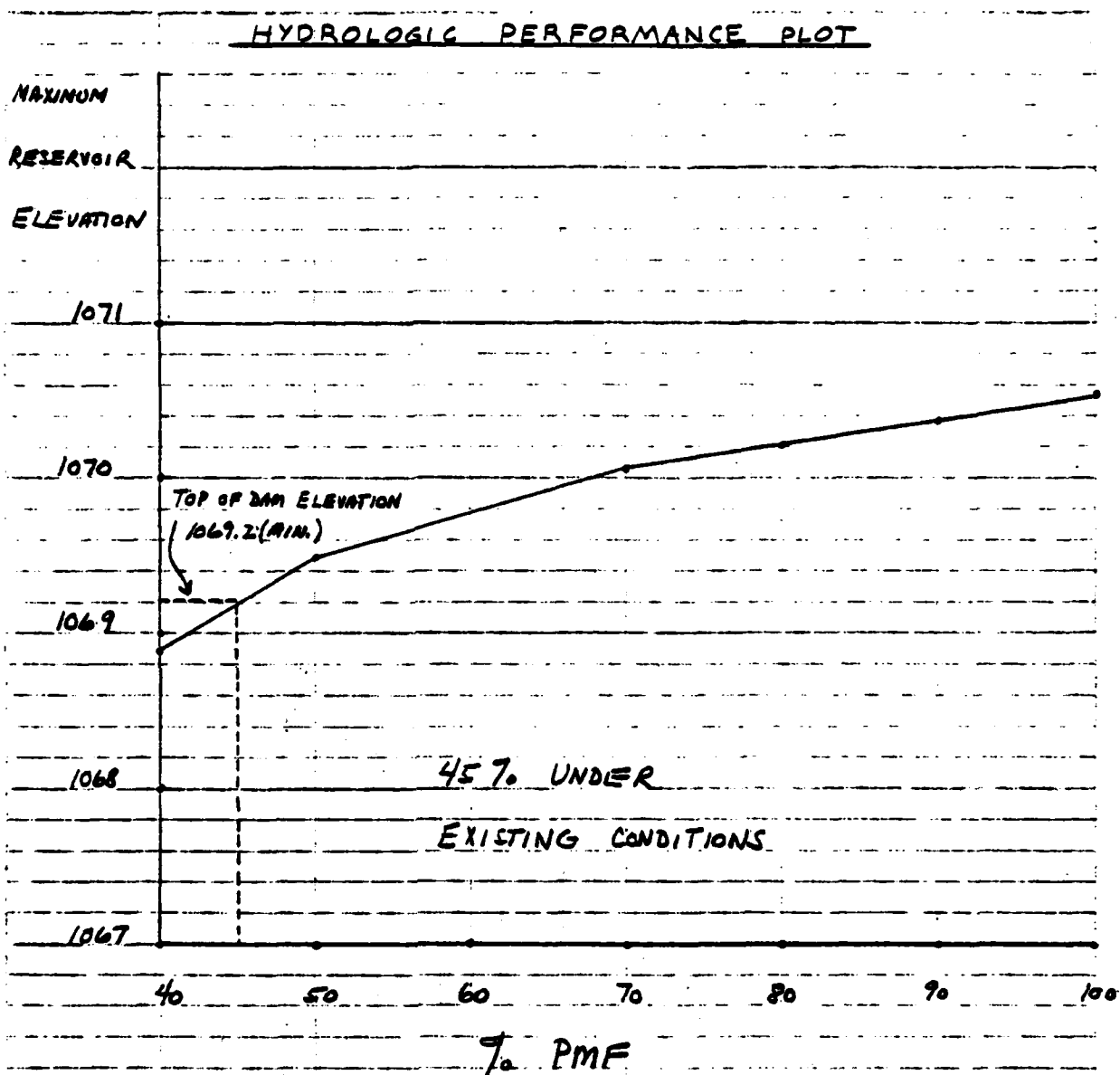
PLAN 1	ELEVATION	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	STORAGE	1064.90	1064.90	1069.20
	OUTFLOW	31.	31.	59.
		0.	0.	969.

RATIO OF PWF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1070.52	1.32	69.	2256.	4.33	16.50	0.0
0.90	1070.38	1.18	68.	2029.	3.67	16.50	0.0
0.80	1070.22	1.02	66.	1803.	3.25	16.50	0.0
0.70	1070.05	0.85	65.	1572.	2.83	16.50	0.0
0.50	1069.47	0.27	61.	1090.	1.08	16.67	0.0
0.40	1068.87	0.0	57.	860.	0.0	16.75	0.0
0.30	1068.17	0.0	52.	641.	0.0	16.75	0.0
0.20	1067.38	0.0	47.	424.	0.0	16.83	0.0
0.10	1066.44	0.0	41.	208.	0.0	16.92	0.0

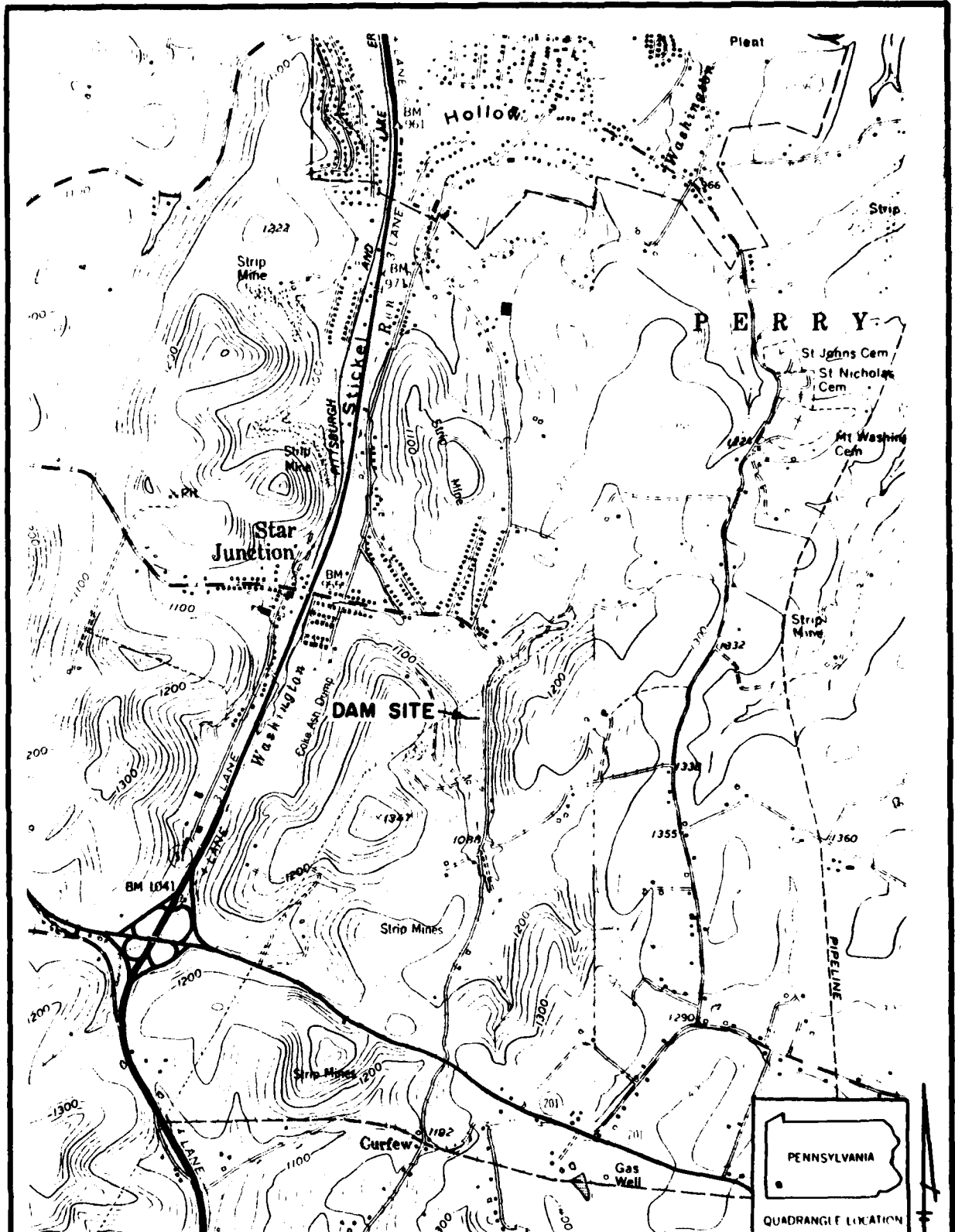
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(412) 531-7111

Sheet _____ of _____

Job STAR JUNCTION No. 2 Dam Job No. 791E2J
Subject SPILLWAY/RESERVOIR RATING CURVE
Made By JPH Date 11-1-80 Checked _____ Date _____



APPENDIX E
PLATES



FAYETTE CITY and DAWSON U.S.G.S. 7 1/2 min. QUADRANGLES

DATE: MARCH 1980

SCALE: 1" = 2000'

DR: JF

CK: JEB

PLATE I

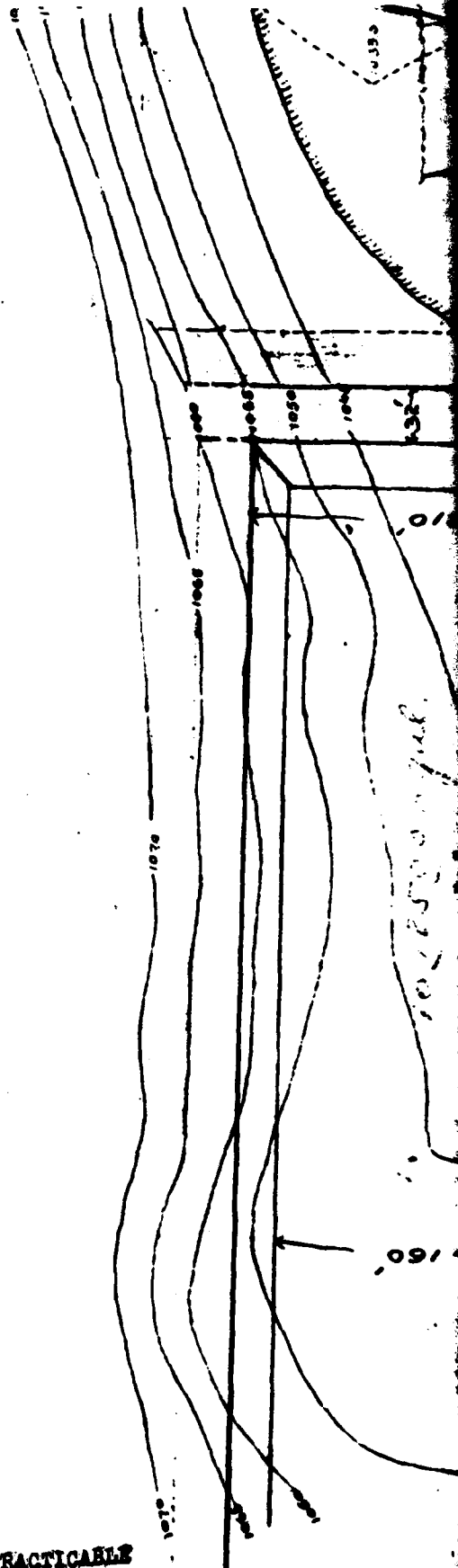
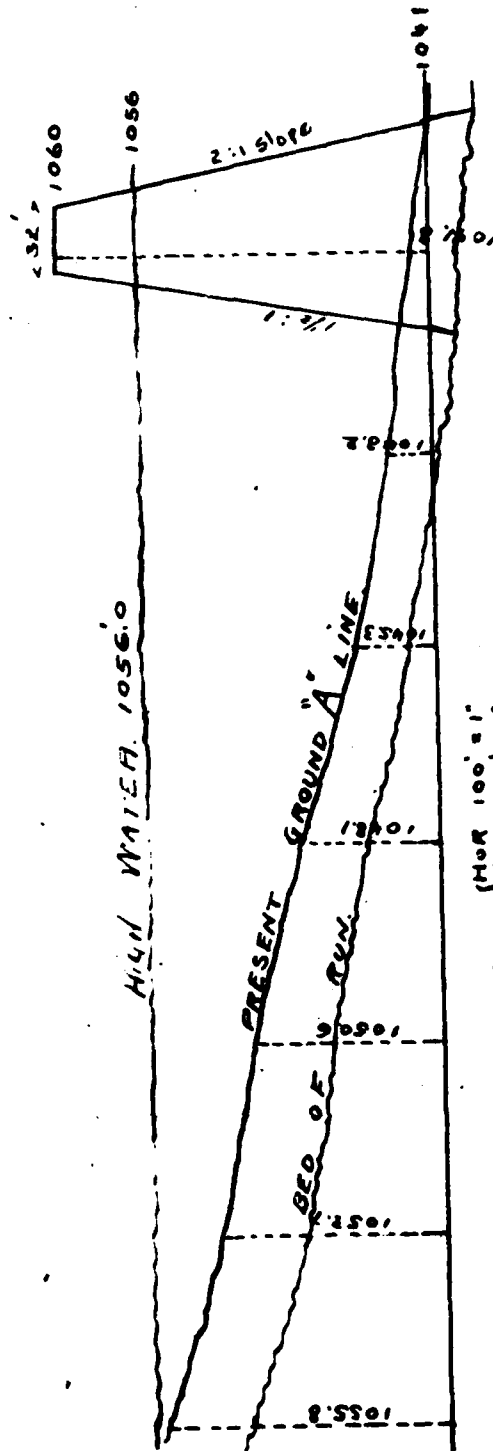
STAR JUNCTION No. 2 DAM
NATIONAL DAM INSPECTION PROGRAM

A. C. ACKENHEIL & ASSOCIATES, INC.
CONSULTING ENGINEERS
PITTSBURGH, PA., CHARLESTON, W. VA. & BALTIMORE, MD.

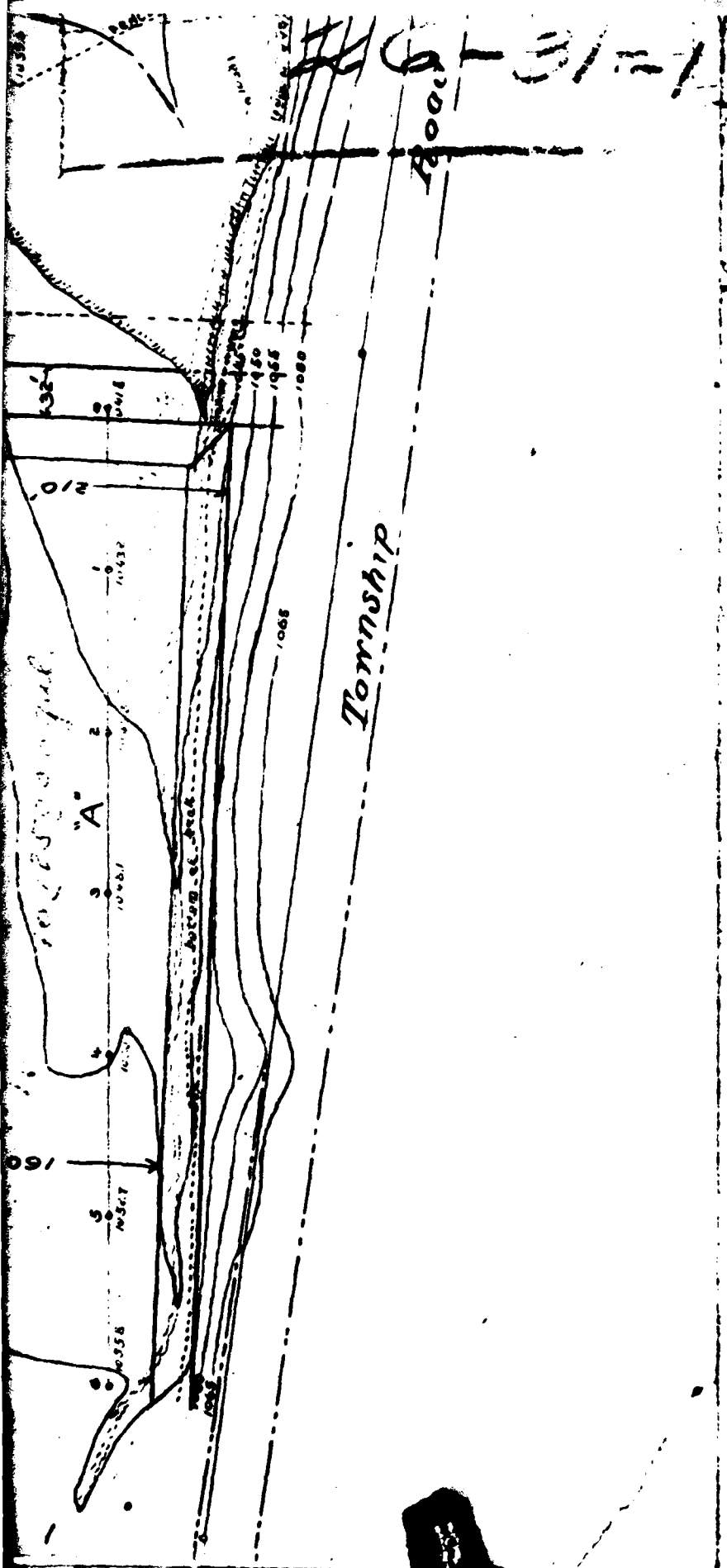
REGIONAL
VICINITY
MAP

LIST OF PLATES

- Plate I Regional Vicinity Map
- Plate II Plan of Reservoir No. 2
- Plate III Plan and Sections of W. C. & C. Co.
No. 2 Reservoir Dam.



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Plan of Reservoir No. 2

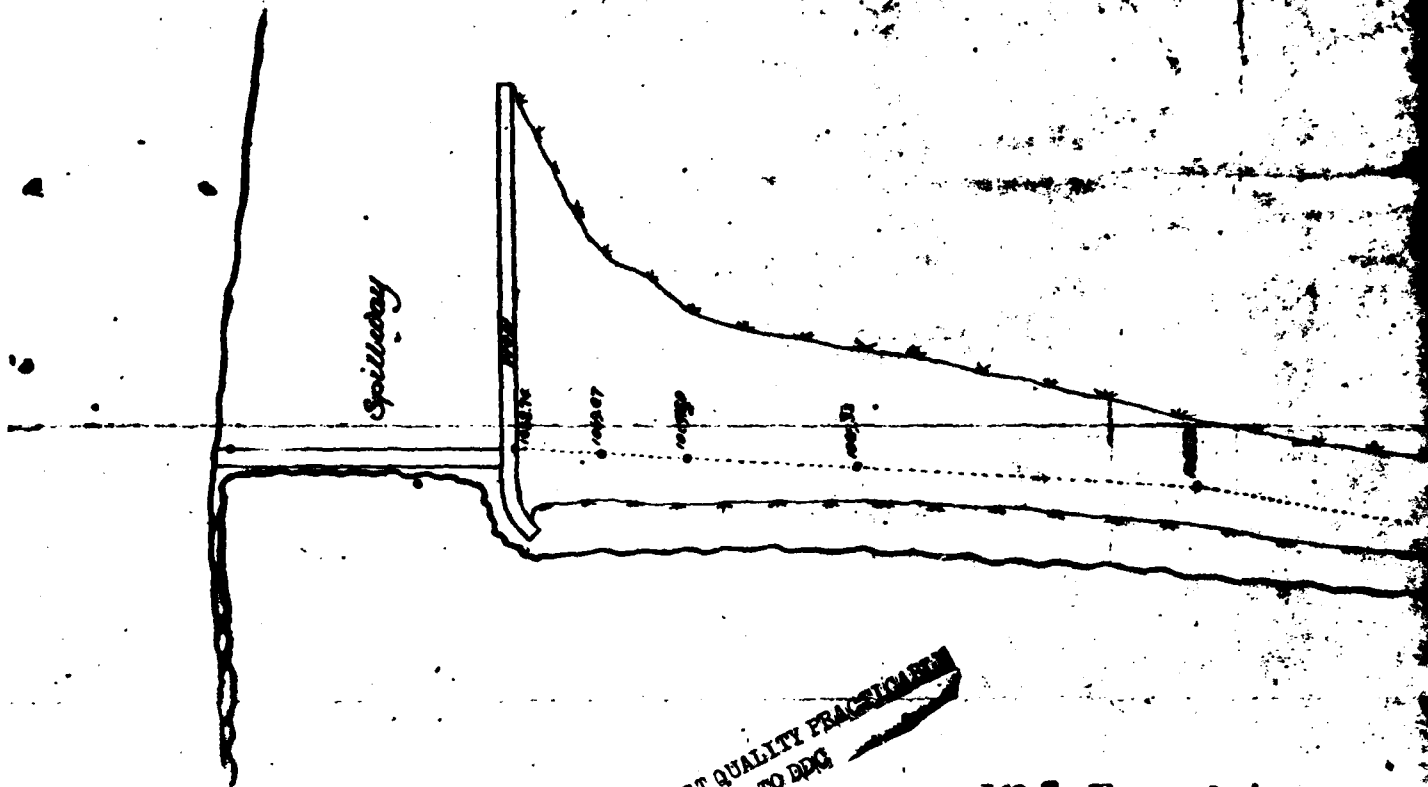
W C & C Co

Star Junction. Scale 100' = 1".

Oct 1900

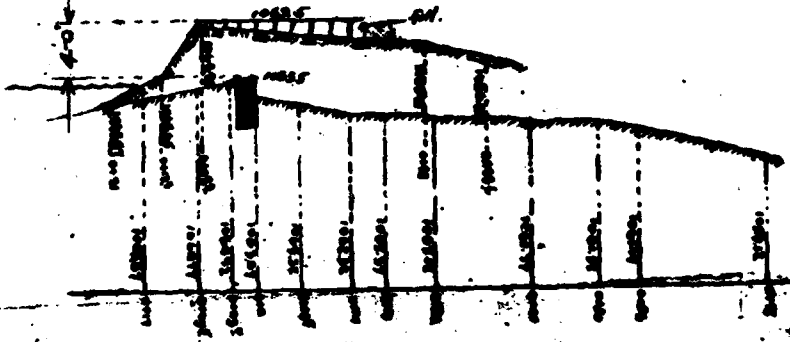
Thos. M. Zimmerman
Dawson Co.

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THIS PAGE IS BEST QUALITY PHOTOGRAPH
FROM COPY FURNISHED TO DDG

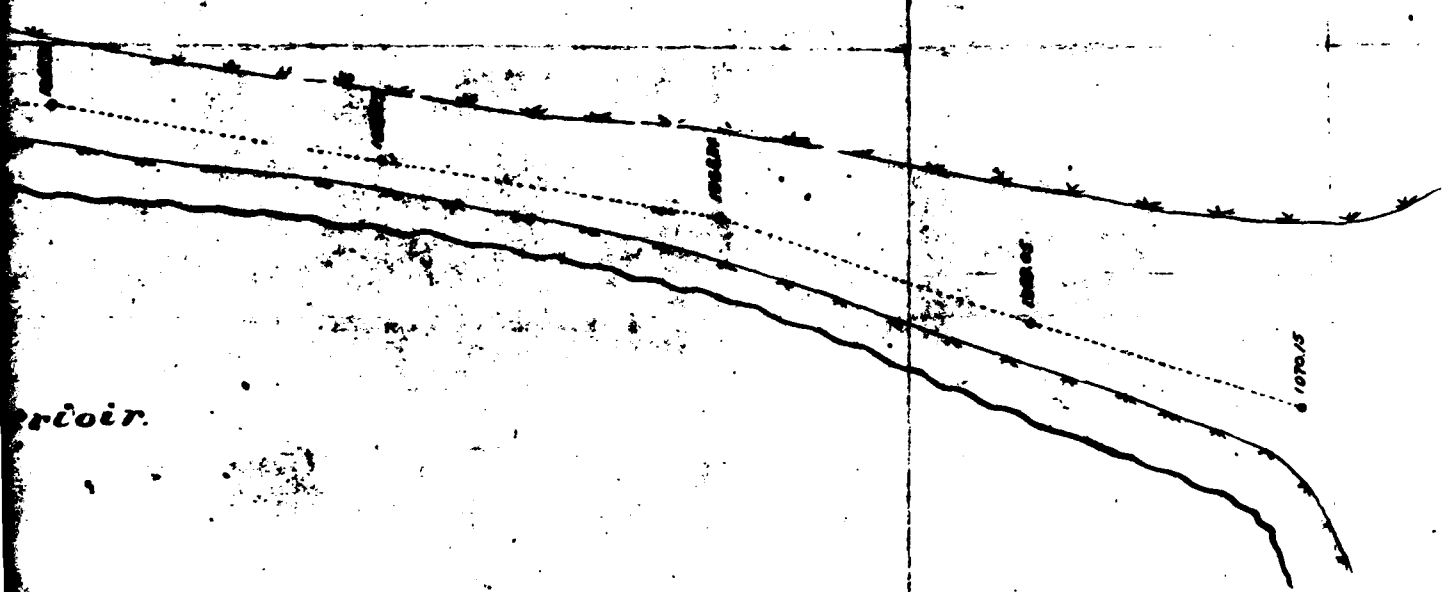
No. 2 Reservoir.
P = 20'



Section through spillway.
Nov 17-26
Nov 20-10



UNIVERSITY ENGINEER
APPROVED



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Plan and sections of WC & CC's No. 2 Reservoir Dam.
showing proposed change on dam and spillway.

June 1915

Thos M Zimmerman Eng



Plate III

2

APPENDIX F

GEOLOGY

GEOLOGY

Geomorphology

Star Junction No. 2 Dam is located within the Pittsburgh Plateau section of the Appalachian Plateau physiographic province. This area is characterized as a mature plateau of nearly flat lying sedimentary rocks dissected by numerous small streams forming in many places steep-sided valleys. No. 2 dam lies on an unnamed tributary of Washington Run immediately south and upstream of the reservoir formed by Star Junction No. 1 Dam, just east of Star Junction, Pennsylvania.

Structure

General: Star Junction No. 2 Dam is located approximately equidistant from the Fayette anticline to the east and the Lambert syncline to the west. Both of these structural features trend NE-SW. According to estimates based on the "Coal and Surface Structure Map of Fayette County, Pennsylvania", the strata in the immediate vicinity of the dam strike at N9°E and dip at 320 feet/mile (3.5°) to the west.

Faults: No observations were made that would indicate faulting in the rocks outcropping around the dam site. In general, only a few evidences of faulting have been observed in all of Fayette County.

Stratigraphy

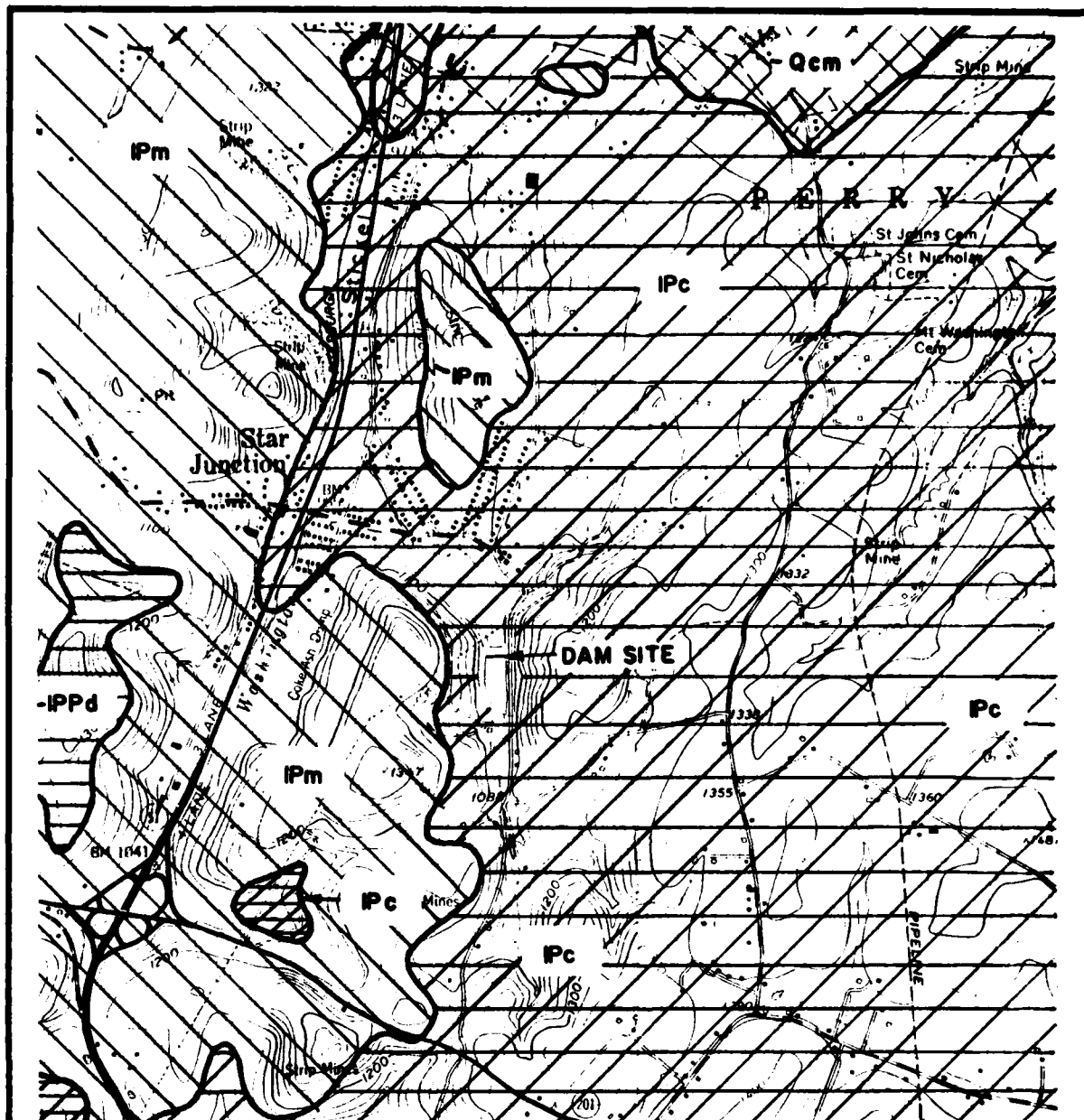
General: The rocks exposed in the immediate area of No. 2 Dam are part of the Conemaugh Group of Pennsylvanian age, and include primarily the uppermost portion of the Casselman Formation. The Pittsburgh Coal Seam, which stratigraphically marks the top of the Conemaugh Group and the base of the Monongahela Group, is estimated to outcrop on the west hillside about 100 feet above the dam.

The following rock units are present in the immediate vicinity of Star Junction No. 2 Dam:


Connellsville Member: The Connellsville member of the Casselman Formation is exposed in the discharge channel downstream of the spillway and along the left abutment. It is characterized as a green brown, thin to medium

bedded sandstone or silty sandstone. It is approximately 65 feet thick.

Little Pittsburgh Member: The little Pittsburgh Member of the Casselman Formation occurs immediately above the Connellsville and is the uppermost member of the Conemaugh Group. This heterogeneous formation is composed of a cyclic sequence of limestone, coal beds, shaley sandstone and clays. Its thickness averages 70 feet.



FAYETTE CITY AND DAWSON QUADRANGLES, FAYETTE COUNTY, PENNSYLVANIA

SCALE:  1:24000
 CONTOUR INTERVAL 20 FT. DATUM IS MEAN SEA LEVEL

— FORMATION CONTACT
 — CONTACT BETWEEN CONEMAUGH & MONONGAHELA

DATA OBTAINED FROM PENNSYLVANIA TOPOGRAPHIC AND GEOLOGIC SURVEY, GEOLOGIC MAP OF FAYETTE COUNTY, PENNSYLVANIA, 1940 and COAL AND SURFACE STRUCTURE MAP OF FAYETTE COUNTY, PENNSYLVANIA, 1940

DATE: MARCH 1980	STAR JUNCTION No.2 DAM NATIONAL DAM INSPECTION PROGRAM A. C. ACKENHEIL & ASSOCIATES, INC. CONSULTING ENGINEERS PITTSBURGH, PA., CHARLESTON, W. VA. & BALTIMORE, MD.	GEOLOGIC MAP
SCALE: AS SHOWN		
DR: JF CK: JEB		

AGE	SCORE	PERCENT	COLUMNAR SECTION	PROMINENT BEDS
QUATERNARY				PLEISTOCENE GLACIAL OUTWASH, RIVER TERRACE DEPOSITS AND ALLUVIUM
PERMAN	DUNKARD (PP-2)	GREENE (PP-1)		UPPER WASHINGTON LIMESTONE
		WASHINGTON COAL		WASHINGTON COAL
		WAYNESBURG SANDSTONE		WAYNESBURG SANDSTONE
		WAYNESBURG COAL		WAYNESBURG COAL
PENNSYLVANIAN	MONONGAHELA (PP-1)	UPPERTOWN SANDSTONE		UPPERTOWN SANDSTONE
		UPPERTOWN COAL		UPPERTOWN COAL
		BENWOOD LIMESTONE		BENWOOD LIMESTONE
		SEWICKLEY COAL		SEWICKLEY COAL
	CONEMAUGH (PP-1)	PITTSBURGH SANDSTONE		PITTSBURGH SANDSTONE
		PITTSBURGH COAL		PITTSBURGH COAL
		CONNELLSVILLE SANDSTONE		CONNELLSVILLE SANDSTONE
		MORGANTOWN SANDSTONE		MORGANTOWN SANDSTONE
	GLENDEN (PP-1)	AMES LIMESTONE		AMES LIMESTONE
		PITTSBURGH RED BEDS		PITTSBURGH RED BEDS
		SALTSBURG SANDSTONE		SALTSBURG SANDSTONE
		MAHONING SANDSTONE		MAHONING SANDSTONE
MISSISSIPPIAN	ALLEGHENY (PP-1)	UPPER FREEPORT COAL		UPPER FREEPORT COAL
		UPPER KITTAUNING COAL		UPPER KITTAUNING COAL
		WORTHINGTON SANDSTONE		WORTHINGTON SANDSTONE
		LOWER KITTAUNING COAL		LOWER KITTAUNING COAL
	POCONO (PP-1)	HOMEROCK SANDSTONE		HOMEROCK SANDSTONE
		MERCER SANDSTONE, SHALE & COAL		MERCER SANDSTONE, SHALE & COAL
		CONNOQUENESSING SANDSTONE		CONNOQUENESSING SANDSTONE
		SURSON SANDSTONE		SURSON SANDSTONE
POCONO (PP-1)	POCONO (PP-1)	CUYAHOGA SHALE		CUYAHOGA SHALE
		BEREA SANDSTONE		BEREA SANDSTONE

DATE: MARCH 1980

SCALE: 1" = 360'

DR:

CK:

DWG. NO.

STAR JUNCTION No 2 DAM
NATIONAL DAM INSPECTION PROGRAM

A. C. ACKENHEIL & ASSOCIATES, INC.
CONSULTING ENGINEERS
PITTSBURGH, PA., CHARLESTON, W. VA. & BALTIMORE, MD.

GEOLOGIC
COLUMN